INSECTS OF MICRONESIA
Diptera: Culicidae*

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INTRODUCTION

The only extensive study previously made on the mosquitoes of Micronesia was that of Bohart and Ingram (1946).[1] More recently the faunas of individual islands have been revised by Knight and Hurlbut (1949) for Ponape, and by Yamaguti and La Casse (1950) for Guam.

Bohart and Ingram treated 21 named species and four unnamed ones from Micronesia and the Volcano Islands. The present list of 45 species from these areas and the Bonins is nearly double that previously known. It probably includes most of those occurring in the area, except in the Palaus where additional forms are certain to be found.

The most obvious and most interesting feature of island faunas is the high percentage of endemism. Table 1 outlines the known geographical distribution of Micronesian mosquitoes. It can be seen that of the 45 species listed, 28 (62.2 percent) are apparently endemic to the area and that 22 of these are endemic to particular island groups. In the Gilberts, the Marshalls, the Caroline atolls, Marcus and Wake Islands, and the Volcano Islands there are no species peculiar to these particular groups. In the remainder of the area the percentage of endemism is 14.3 in the northern Marianas, 18.2 on Yap, 25.0 in the Bonins, 28.6 in the southern Marianas, 30.0 on Truk, 33.3 on Kusaie, 33.3 in Palau, and 42.9 on Ponape. On the other hand, the largest number of endemics (six) have been found in the Palaus, the next largest (four) in the southern Marianas, followed by Ponape and Truk with three each, the Bonins and Yap with two each, and the northern Marianas and Kusaie with one each.

An analysis of the figures on endemism indicates that, not only has isolation been an essential factor, but the longer time for development available on the larger and presumably more ancient islands has been even more important. All genera and subgenera of Micronesian mosquitoes have a wide distribution outside the area.

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* This represents, in part, Professor T. Esaki's Micronesian Expeditions (1936-1940), No. 86.
[1] Dates in parentheses refer to Bibliography, Insects of Micronesia, volume 2.

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The following symbols indicate the institutions in which specimens are stored: US (United States National Museum), CM (Chicago Natural History Museum), and KU (Kyushu University).

Abbreviations used in taxonomy are illustrated in figure 1.

SOURCES OF SPECIMENS ILLUSTRATED IN FIGURES

Bonin Islands: Chichi Jima, 2, *a, e, h, m;* 3, *a;* 4, *e-h;* 13, *e-g, i-l;* 14, *a, b, i, j.*

Mariana Islands: Agrihan Island, 5, *a, d, i, m;* 6, *e, g, i.* Pagan Island, 7, *d.* Anatahan Island, 11, *a, j, k.* Saipan Island, 5, *b, c, e, f, j, n;* 6, *c, d, f.* Rota Island, 5, *g, k, p;* 6, *b;* 14, *c, d.* Guam Island, 5, *h, l, q;* 6, *a, h;* 8, *c, j, p;* 9, *i;* 10, *c;* 11, *b;* 14, *g, h.*

Marshall Islands: Arno Atoll, 8, *k;* 10, *e.* Majuro Atoll, 8, *d, s.* Lae Atoll, 9, *d, h.*

Caroline Islands: Kusaie Island, 10, *d;* 12, *g-i, j, k.* Ponape Island, 7, *c, j;* 11, *i;* 13, *a.* Nukuoro Atoll, 10, *g.* Truk Islands, 7, *b, e, f;* 11, *e, f, l;* 12, *a-c;* 14, *e, f.* Elato Atoll, 10, *f.* Ulithi Atoll, 8, *e, q;* 9, *j.* Yap Islands, 7, *g, h, i;* 11, *g, h;* 12, *d-f;* 13, *c-d.* Babelthuap Island, 2, *g, n;* 3, *f;* 13, *h.* Koror Island, 3, *e;* 8, *a, g, h, n, o;* 9, *a, c, e;* 10, *a.* Ngergoi (Garakayo) Island, 2, *b, d, i, j, k, l;* 3, *b, d;* 4, *i-l;* 8, *b, i, l, r;* 9, *b, f;* 10, *b.* Peleliu Island, 3, *c;* 4, *a-d;* 13, *b.* Angaur Island, 2, *c, f.*

Ryukyu Islands: Okinawa Island, 7, *a.* Iriomote Island, 14, *k.*

New Guinea: Milne Bay, 8, *f, m, t;* 10, *h.* Hollandia, 9, *g.*

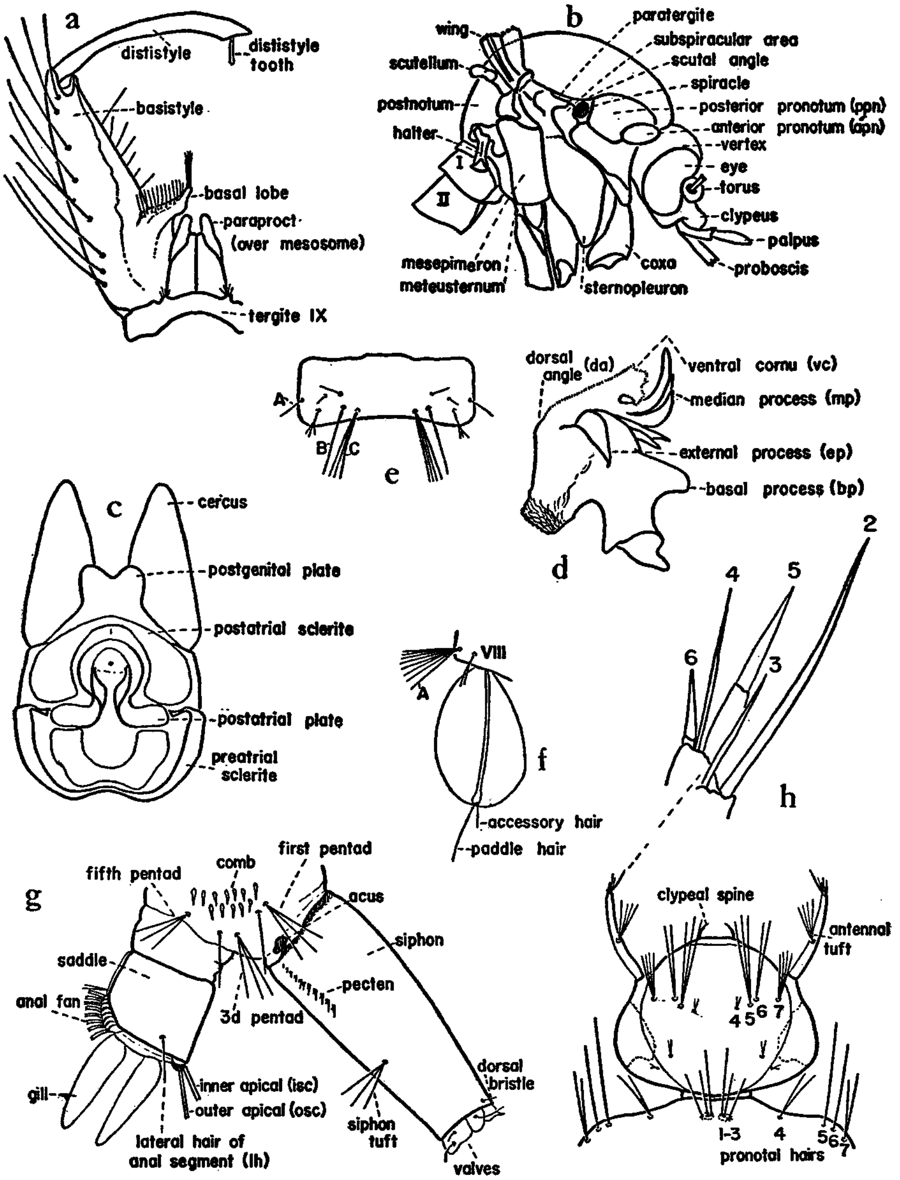

FIGURE 1.—Anatomical details and abbreviations used in keys and descriptions: **a**, *Aedes*, male genitalia; **b**, mosquito adult anatomy; **c**, *Aedes* (*Aedes*), female genitalia; **d**, *Culex*, mesosome plate; **e**, pupal abdomen, tergite II; **f**, *Culex*, pupal paddle; **g**, *Aedes*, larva terminal segments; **h**, *Aedes*, larva anterior.

Key to Mosquitoes of Micronesia

ADULTS

1. Scutum with a narrow, silvery-white to yellowish median stripe 2
   Scutum with a different pattern or an indefinite one or all dark 15
2. Scutum with whitish or golden scales anterolaterally, at least at scutal angle.... 3
   Scutum without whitish or golden scales anterolaterally 9
3. Scutal markings white or slightly offwhite; subspiracular area with an anterior patch of silvery scales 4
   Scutal markings with a definite yellowish or golden tint; subspiracular area sometimes with a few scales 5
4. Hind tarsal V all white except for an inner black line; lateral scutellar lobes with silvery scales (fig. 7, *f*) (Truk) .... **Aedes scutoscriptus**
   Hind tarsal V dark except for an outer basal white spot; lateral scutellar lobes silvery in male, black in female (Ponape) .... **Aedes hakanssoni**
5. Abdominal tergites with complete or nearly complete pale bands at least on III or IV (fig. 5, *e, f*) 6
   Abdominal tergites with lateral or sublateral spots (fig. 5, *d, g, h*) 7
6. Median scutal stripe not much narrowed posteriorly; front tarsal II with a prominent basal white spot (Tinian, Saipan) .... **Aedes neopandani**
   Median scutal stripe strongly narrowed posteriorly; front tarsal II with an inconspicuous basal pale spot (northern Marianas from Tinian to Pagan) .... **Aedes saipanensis**
7. Abdominal tergites with small subbasal lateral spots (fig. 5, *g*) with both narrow curved and broad appressed scales on mid-lobe of scutellum (Rota) .... **Aedes rotanus**
   Abdominal tergites with laterobasal spots; few if any, narrow curved scales on mid-lobe of scutellum 8
8. Halter knob with pale scales; abdominal tergites with small laterobasal spots (fig. 5, *h*) (Guam) .... **Aedes pandani**
   Halter knob with dark scales; abdominal tergites with large laterobasal spots (fig. 5, *d*) (Agrihan) .... **Aedes agrihanensis**
9. Pale streak on anterior surface of hind femur tapering off ventrally (fig. 8, *o, p, r*) 10
   Pale streak on anterior surface of hind femur tapering to a median point 12
10. Hind tarsus with all white marks broken by a continuous black line on inner surface (fig. 8, *c*); abdominal tergites with laterobasal white spots appearing subbasal in dorsal view (fig. 8, *j*) (Guam, Rota, Saipan) .... **Aedes guamensis**
    Hind tarsus with some complete white bands; abdominal tergites usually with some nearly complete subbasal bands 11
11. Pale band on hind tarsal IV usually interrupted, at least in female, by a broad black line on inner surface (fig. 8, *i*); hind tarsal V all white except for a narrow interruption on inner surface (Palau Islands) .... **Aedes palauensis**
    Pale band on hind tarsal IV complete (fig. 8, *h*); hind tarsal V black apically (Palaus: Koror) .... **Aedes dybasi**
12. Basal two-thirds or more of hind tarsal IV white (fig. 8, *f*), V usually all white[2] 13
    Less than basal two-thirds of hind tarsal IV white, V usually dark apically[2] 14

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[2] In doubtful cases it will be necessary to examine larvae or dissected male genitalia mounts.

13. Pleural markings essentially linear (Palaus, New Guinea, New Hebrides, etc.) .... **Aedes scutellaris**
Pleural markings essentially in patches (Marianas, Bonins, Hawaii, Oriental Region) .... **Aedes albopictus**
14. White mark on hind tarsal IV covering one-fifth to two-fifths of segment (fig. 8, *d*) (Marshalls, Gilberts)[2] .... **Aedes marshallensis**
White mark on hind tarsal IV covering three-tenths to three-fifths of hind tarsal IV (fig. 8, *e*) (Carolines)[2] .... **Aedes hensilli**
15. Tarsi with bands of pale scales 16
Tarsi dark-scaled or without definite bands 30
16. Wings conspicuously spotted or sprinkled with light scales 17
Wings dark-scaled except sometimes for a basal costal spot 22
17. Hind tarsal II with a narrow apical pale band 18
Hind tarsal II with a broad apical pale band occupying one-quarter or more the length of the segment 20
18. Abdomen unscaled, at least on segments I-VI; proboscis dark; palpus clubbed in male, palpi long in both sexes (Guam) .... **Anopheles subpictus indefinitus**
Abdomen clothed with a mixture of light and dark scales; proboscis banded and spotted; palpus not clubbed in male 19
19. Wing scales mostly very broad; hind tarsals III-V mostly white; femoro-tibial joints with patches of shaggy scales; palpi short in both sexes (Yap, Woleai Atoll, Palaus) .... **Aedeomyia catasticta**
Wing scales only slightly broadened; hind tarsals III-V mostly dark, femoro-tibial joints not shaggy; male palpus long (Babelthuap) .... **Culex bitaeniorhynchus**
20. Halter knob pale-scaled 21
Halter knob dark-scaled (Koror Island) .... **Aedes hui**
21. Pale band of hind tarsal III about as long as V (fig. 2, *b*); dorsum of abdominal tergites II-V dark brown with yellowish spots (fig. 2, *j*); subapical black band of proboscis much longer than apical pale part (fig. 2, *l*) (Palaus: Angaur, Peleliu, Ngergoi) .... **Aedes lewelleni**
Pale band of hind tarsal III shorter than V; dorsum of abdominal tergites II-V pale yellow with dark spots (fig. 2, *i*); subapical black band of proboscis about as long as or shorter than apical pale part (fig. 2, *k*) (Palaus: Ngergoi, Angaur) .... **Aedes gressitti**
22. Proboscis dark or without a well-defined pale median band 23
Proboscis with a well-defined pale median band 26
23. Vertex with a patch of broad silvery scales projected between tori 24
Vertex without silvery scales projected between tori 25
24. Scutum marked with two submedian white lines and a bowed lateral line; clypeus with two spots of silvery scales (widespread) .... **Aedes aegypti**
Scutum dark-scaled (fig. 7, *g*); clypeus not scaled (Yap group) .... **Aedes maehleri**
25. Tarsal pale bands covering the joints (fig. 2, *a*); distal two-fifths of anterior surface of hind femur dark except for the knee spot (Bonins, Asian coast) .... **Aedes togoi**
Tarsal pale bands basal only; distal two-fifths of anterior surface of hind femur speckled (Australasian Region) .... **Aedes vexans nocturnus**
26. Mid-femur all dark-scaled on anterior surface 27
Mid-femur speckled with light and dark scales on anterior surface 28
27. Scutal scales whitish yellow; pale bands on abdominal tergites covering one-half or more of segments II-VII (Marianas) .... **Culex litoralis**
Scutal scales coppery; pale bands on abdominal tergites II-VII narrow (Bonins, Oriental Region) .... **Culex tritaeniorhynchus**

8. Lateral plate of mesosome roughly L-shaped in lateral view 9
   Lateral plate of mesosome not L-shaped 10
9. Lateral plate of mesosome with a group of prominent teeth at about the middle of the concave surface (fig. 13, *f*) .... **Culex vorax**
   Lateral plate of mesosome with inconspicuous teeth (fig. 13, *h*) .... **Culex fuscanus**
10. Median process of mesosome plate simple (fig. 14, *b*) .... **Culex quinquefasciatus**
    Median process of mesosome plate with several teeth 11
11. Lateral plate of mesosome with toothlike spicules concentrated at dorsal angle of ventral cornu 12
    Lateral plate of mesosome with fine, even spiculation or with minute spiculation at dorsal angle as seen under "high-dry" magnification 13
12. Lateral plate of mesosome with external process projecting beyond median process in lateral view (fig. 14, *f*); leaflet of subapical lobe of dististyle more than one-half as broad as long .... **Culex annulirostris**
    Lateral plate of mesosome with external process in the form of a stout curved horn (fig. 14, *d*); leaflet of subapical lobe of dististyle less than one-half as broad as long .... **Culex litoralis**
13. Basal arm of paraproct weakly developed .... **Culex bitaeniorhynchus**
    Basal arm of paraproct stout and strong 14
14. Distal division of subapical lobe of dististyle bearing a bristle, two stout and comb-tipped rods, and a paddle-like rod .... **Culex tritaeniorhynchus**
    Distal division of subapical lobe of dististyle bearing a bristle and three rather slender rods of which two have faint apical spicules .... **Culex sitiens**
15. Dististyle tooth expanded fanlike or comblike 16
    Dististyle tooth not fanlike or comblike 17
16. Dististyle tooth about two-thirds as long as dististyle proper, long fan-shaped with serrated area (fig. 11, *f*) .... **Aedes lamelliferus**
    Dististyle tooth about one-sixth as long as dististyle proper, comblike with about 25 individual teeth .... **Aedeomyia catasticta**
17. Mesosome tubelike or scoop-shaped, not bearing sclerotized teeth, tube sometimes with terminal leaflets 18
    Mesosome divided into lateral plates bearing sclerotized teeth (best seen under "high-dry" magnification) 24
18. Mesosome bearing leaflets at its apex .... **Anopheles subpictus indefinitus**
    Mesosome without apical leaflets 19
19. No large bent seta near base of basistyle 20
    A large bent seta near base of basistyle 21
20. With a tuft of large scales toward inner apex of basistyle; dististyle tooth about one-half as long as dististyle proper (fig. 3, *c*) .... **Aedes dorseyi**
    Without a scale tuft toward apex of basistyle; dististyle tooth about one-fourth as long as dististyle proper (fig. 3, *a*) .... **Aedes togoi**
21. Harpago blunt at apex; basistyle with a long inner row of about 13 golfclub-like setae distal to inner basal specialized seta (fig. 3, *b*) .... **Aedes lewelleni**
    Harpago sharply pointed, basistyle without a row of clublike setae 22
22. With a prominent tuft of broad scales on inner margin of basistyle beyond middle; a discrete patch of bristles ventrad of the scale tuft (fig. 3, *e*) .... **Aedes hui**
    With only a few long scales on inner margin of basistyle 23
23. Basistyle with two long narrow scales projecting from inner margin; harpago with a long slender recurved tip (fig. 3, *d*) .... **Aedes gressitti**
    Basistyle with a row of four long scales projecting from inner margin; harpago with a short recurved tip (fig. 3, *f*) .... **Aedes sp. in kochi group**

24. Diststyle tooth distinctly longer than greatest breadth of diststyle........................25
    Diststyle tooth about as long as or shorter than greatest breadth of diststyle......28
25. Tergite IX with a strong, median, posteriorly directed angle (fig. 7, *d*)..........
    ....**Aedes albopictus**
    Tergite IX not pointed medially..26
26. Basal lobe of basistyle with heavy setae borne on a distinct, thumblike projection...27
    Basal lobe of basistyle with heavy setae, if any, not borne separately..................
    ....**Aedes scutellaris subgroup in part**[3]
27. Basal lobe of basistyle with thumblike projection opposing an enlarged outer sublobe (fig. 10, *d, e*)..**Aedes marshallensis**
    Basal lobe of basistyle tapering from point of origin to thumblike projection (fig. 7, *b*) ....**Aedes scutoscriptus**
28. Paraproct crowned with teeth or topped by two lobes.......................................29
    Paraproct rounded or bluntly pointed apically..31
29. Paraproct crowned with about five stout teeth.................................**Mansonia crassipes**
    Paraproct bilobed at apex...30
30. With a row of three or four long hairs situated between tooth and outer apex........ of diststyle (fig. 11, *b*)..**Aedes oakleyi**
    With a row of many small hairs extending from outer apex of diststyle half way toward tooth...**Aedes senyavinensis**
31. Diststyle tooth double...32
    Diststyle tooth single...34
32. Diststyle more than four times as long as its greatest breadth (fig. 5, *p*)..........
    ....**Aedes rotanus**
    Diststyle less than four times as long as its greatest breadth...............................33
33. Inner edge of diststyle nearly straight or somewhat wavy in profile (fig. 5, *m*)
    .... **Aedes agrihanensis**
    Inner edge of diststyle distinctly concave in profile (fig. 5, *n*)......**Aedes saipanensis**
34. Diststyle blunt at apex, tooth long enough to project beyond apex.............................35
    Diststyle apex projecting sharply above tooth...36
35. Ninth tergite slightly irregular between pubescent angles; mesosome lobe crowned with four teeth; diststyle tooth stout (fig. 7, *h*)................**Aedes maehleri**
    Ninth tergite with a deep V-shaped indentation; mesosome lobe crowned with many teeth; diststyle tooth slender (fig. 7, *a*)...................................**Aedes aegypti**
36. Basal lobe of basistyle situated about at basal one-third.....**Aedes vexans nocturnus**
    Basal lobe of basistyle situated about at middle...37
37. Diststyle tooth sharply pointed, diststyle apex somewhat hooked (fig. 5, *o*)
    .... **Aedes neopandani**
    Diststyle tooth apically blunt, diststyle not apically hooked (fig. 5, *q*)..........
    ....**Aedes pandani**

PARTIAL KEY TO PUPAE

1. Abdominal seta A (or hair 7) conspicuous, spinelike and placed at or very near posterolateral corner of segments IV-VI.. 2
   Abdominal seta A not spinelike or somewhat removed from posterolateral corner of segments IV-VI... 3

[3] Individual species are best distinguished by comparison of figures of basal lobe of basistyle (fig. 10, *a-i*).

22. Upper head hair (5) single or rarely double, hair 4 with three to five branches (fig. 4, *j*) .... **Aedes lewelleni**
Upper head hair (5) with more than five branches, hair 4 with more than eight branches .... **Aedes hui**

23. Upper head hair (5) single (fig. 11, *l*); anal gills tapering; siphon tuft single and near middle of tube (fig. 11, *e*) .... **Aedes lamelliferus**
Upper head hair multiple (fig. 4, *f*); anal gills globular; siphon tuft multiple and near apex of tube (fig. 4, *h*) .... **Aedes togoi**

24. Pronotal hair 3 with many branches 25
Pronotal hair 3 single to triple 29

25. Anal plate without a dense tuft of spines ventral to lateral hair insertion; typical comb scale not more than three times as long as its basal attachment 26
Anal plate with a dense tuft of spines ventral to lateral hair insertion; typical comb scale more than three times as long as its basal attachment 27

26. With two pairs of well-developed dorsal abdominal stellate hair tufts; lateral hair of anal segment stout and less than one-half as long as ventral length of siphon tube; dorsal preapical siphon bristle single (fig. 6, *e*) .. **Aedes agrihanensis**
With one pair of well-developed dorsal abdominal stellate hair tufts; lateral hair of anal segment more than one-half as long as ventral length of siphon tube; dorsal preapical siphon bristle usually double, at least on one side (fig. 6, *f*) .... **Aedes neopandani**

27. Clypeal spine double or multiple; pecten teeth without obvious subteeth; dorsal preapical siphon bristle about as long as apical diameter of tube (fig. 6, *a*) .... **Aedes pandani**
Clypeal spine single; pecten teeth with one to three side teeth; dorsal preapical bristle shorter than apical diameter of tube 28

28. Anal plate with dense covering of overlapping spicules from either side of lateral hair to base (fig. 6, *b*) .... **Aedes rotanus**
Anal plate with rows of minute spicules basad of lateral hair (fig. 6, *d*) .... **Aedes saipanensis**

29. Most posterior hairs of anal fan with two or more branches 30
Most posterior hairs of anal fan single 34

30. Outer apical bristle (*osc*) of anal segment with two or more branches from base .. 31
Outer apical bristle (*osc*) single or split at some distance from base 32

31. Comb scales simple, finely setulose to near tip; apical margin of anal plate with prominent spines; with short spines at base of mesopleural and metapleural hairs (fig. 7, *i*) .... **Aedes maehleri**
Comb scales with strong side teeth toward base; apical margin of anal plate without prominent spines; with long, stout spines at base of mesopleural and metapleural hairs .... **Aedes aegypti**

32. Comb scales attached at base to form a sclerotized plate; anal plate densely spiny at apex (fig. 4, *d*); upper and lower head hairs (5 and 6) many-branched .... **Aedes dorseyi**
Comb scales not attached to a plate; anal plate with minute spicules at apex; upper and lower head hairs single or double, rarely triple 33

33. Pecten row with distal teeth more widely spaced; hairs of anal fan and inner apical bristle of anal segment (*isc*) with many branches; lateral hair of anal segment fine and short; pentad hairs I and II arising from a sclerotized plate (fig. 11, *c*) .... **Aedes vexans nocturnus**
Pecten row evenly spaced; anal fan hairs and *isc* with not more than four branches; lateral hair of anal segment long and double or triple; pentad hairs I and II not arising from a sclerotized plate .... **Aedes hakanssoni**

34. Lateral hair of anal segment with branches unequal, usually double........................35
Lateral hair of anal segment with branches of approximately equal strength and nearly equal length, double to sextuple........................36
35. Comb teeth with side hairs extending more than one-half the distance from lowest point of attachment to tip of scale (fig. 9, *h*)................**Aedes marshallensis**
Comb teeth with side hairs extending less than one-half the distance from lowest point of attachment to tip of scale (fig. 9, *g*, *j*)........................**Aedes hensilli, Aedes scutellaris, Aedes albopictus**
36. Pecten in slightly curved row of seven to 17 teeth; lateral hair of anal segment double or rarely single; comb of five to eight scales (fig. 7, *e*)........................**Aedes scutoscriptus**
Pecten in a straight row........................37
37. Head distinctly longer than broad; pecten of one to four teeth, usually two or three; siphon hairs double or single; pentad hairs I and V usually single (fig. 9, *a*, *e*)........................**Aedes dybasi**
Head about as broad as long; pecten usually with more than four teeth; siphon hair with three or more branches; pentad hairs I and V usually with three to five branches........................38
38. Comb scales without fine side hairs beyond point of attachment (fig. 9, *f*); pecten rarely of more than eight teeth, usually four to seven; anal gills equal or slightly unequal in length........................**Aedes palauensis**
Comb scales with fine hairs extending more than one-half the distance from lowest point of attachment to tip of scale (fig. 9, *i*); pecten rarely of fewer than 11 teeth, usually 11-16; anal gills markedly unequal, dorsal pair the longer........................**Aedes guamensis**

Genus **Anopheles** Meigen

Subgenus **Myzomyia** Blanchard

1. **Anopheles (Myzomyia) subpictus indefinitus** (Ludlow).

Myzomyia rossi indefinita Ludlow, 1904, Canadian Ent. **36**: 299 (four female cotypes, U. S. Nat. Mus.).

Anopheles ludlowi Theobald, of Dyar, 1925, Ins. Inscit. Mens. **13**: 86.

Anopheles subpictus indefinitus King, 1932, Philippine Jour. Sci. **47**: 325, pl. 2 (fig. 2), pl. 3 (fig. 2), pl. 4 (fig. 2), text figs. 1-6.—Russell and Baisas, 1934, Philippine Jour. Sci. **55**: 326, pl. 24, pl. 29 (fig. C), pl. 32 (figs. 4, 6, 11), text figs. 1-4.—Russell and Baisas, 1936, Philippine Jour. Sci. **59**: 45, pl. 20.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 12, pls. 1, 2.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31** (5): 643.—Hull, 1952, U. S. Armed Forces Med. Jour. **3**: 1288.

Female: Length of wing about 3.0 mm. Vertex with median area of many white upright scales; palpus with a broad apical white band and two narrow bands, subapical one about one-half as long as apical; proboscis dark. Scutum pale-scaled, darker laterally; wing with about 30 to 33 dark spots of scales in addition to a spotted fringe, preapical costal spot about as long as preceding white spot; prehumeral costal spot usually unbroken to base of wing. Femora speckled dorsally, pale ventrally; tarsi with joint bands, narrow on hind tarsus and mainly apical, absent over last joint of mid- and fore-tarsi. Abdomen light, with golden hairs and some narrow yellowish and dark scales posteriorly on VII and VIII.

series of both sexes on the island of Iriomote in the southern Ryukyus during November 1951. The species has not previously been reported from Micronesia, but its establishment in the Carolines is indicated by specimens from Koror, Babelthuap, and Yap.

PALAU. BABELTHUAP: Ten males, one female, Ulimang, at light and sweeping in woods, Dec. 1947, Dybas; one male, one female, Iwang, Dec. 1952, Gressitt. KOROR: Two females, day-biting, in woods, Nov. 1947, Jan. 1948, Dybas; nine males, four females, Oct., Dec. 1952, Beardsley, Gressitt.

YAP. YAP: Two males, Kolonia, July-Aug. 1950, Goss; five males, two females, Mt. Madaade and Mt. Tabiwol, Oct. and Nov. 1952, Gressitt, Krauss.

About 10 species of the subgenus are known from the Oriental and Australian Regions. Among these, *crassipes* is distinguished by the dark-scaled legs and wings, and by more or less extensive purple scaling on the first four or five abdominal tergites. The dististyle of the male genitalia is distinctive in having a membranous fingerlike projection from the inner surface before the middle. In the larva the long, slender comb scales and absence of tufts piercing the anal ring are specific characters.

Genus **Aedeomyia** Theobald

3. **Aedeomyia catasticta** Knab.

Aedeomyia catasticta Knab, 1909, Ent. News **20** (9): 387 (type female, U. S. Nat. Mus.).

Aedomyia venustipes (Skuse), of Barraud, 1934. Fauna India, Dipt. **5**: 132, figs. 32, 33.

Aedomyia catasticta Knab, of Mackerras, 1937, Linn. Soc. New South Wales, Proc. **62**: 259, figs. 1-5.

Female: Body covered with white, black and yellow scales, three white rings of scales on palpus and two on proboscis; palpus about two-ninths as long as proboscis; scutum with a broad median stripe of yellowish scales; wing spotted with broad, dark-brown, yellow, and white scales; tufts of suberect scales at tips of mid- and hind-femora; tarsi with joint bands, hind tarsal V all white. Dorsum of abdomen with yellowish scales and lateral patches of white ones.

Male: Penultimate antennal segment without basal whorl of long hairs; palpus about as in female. Dististyle tooth comblike.

Larva (based on six specimens from Yap): Antenna with very long hairy shaft, apical hairs subplumose, median antennal tuft about 10-branched. Head hairs 5 and 6 multiple; mentum with five teeth. Comb teeth long and bristle-like, in a row of 10 to 15 along posterior margin of a thinly sclerotized plate; first and third pentads with several long branches, fifth with many shorter ones; siphon short, setose, with a subventral long, branched hair, another branched hair and a stout curved spine on ventral valve; acus present, pecten absent. Saddle long setose dorsolaterally, with equal-branched lateral hair, about 12 hairs in anal fan; gills shorter than saddle; *isc* and *osc* single; plumose dorsally.

Biology: According to Mackerras (1937) the pale-green larvae live in swamps and cling tenaciously to underwater stems of *Nitella,* from which by

an unexplained means they appear to obtain oxygen. These habits are similar to those reported for other members of the genus. The adults are attracted to lights and the feeding habits of females are unknown.

DISTRIBUTION: Widespread in the Oriental Region and known also from Australia and Fiji. The type locality is the Philippine Islands. The following records from the Caroline Islands are the first reported from Micronesia.

PALAU. BABELTHUAP: Two females, Ulimang, at light, Dec. 1957, by Dybas; four females, east Ngatpang, Dec. 1952, Gressitt. KOROR: One female, at light, Nov. 1947, Dybas; three females, Sept. 1952-Apr. 1953, Beardsley, Gressitt. ANGAUR: One male, three females. Aug. 1945, Feb. 1948, Dybas.

YAP. YAP: Ten females, Kolonia, at light, Mar. 1949, Maehler; two males, 17 females, six larvae, Kolonia, Kanif, Dugor, Tomil, July-Aug. 1950, Goss; eight females, hill behind Yaptown, at light, Dec. 1952, Gressitt.

CAROLINE ATOLLS. WOLEAI: One female, Nov. 1952, Krauss.

As pointed out by Mackerras (1937), the common Australian and Oriental species is *catasticta,* and *venustipes* (Skuse) is a rare species found only in Australia. The wing of *catasticta* has four white costal spots rather than three, and larval head hair 4 is much smaller than 5 or 6. In the Carolines this species could only be confused with one of the *Aedes kochi* group, which also have black and white broad wing scales. However, *catasticta* has pale tarsal bands covering the joints and has short palpi in the male. The pupal chaetotaxy has been described and figured by Baisas (1938, Monogr. Bull. Bur. Health, Manila **18**: 175-232) and Penn (1949, Pacific Science **3**: 3-85). Characteristic are the stout lateral abdominal setae which are similar to those found in species of *Anopheles.* The paddle has a single long terminal seta.

Genus **Aedes** Meigen

Subgenus **Finlaya** Theobald

Group A (*kochi* group)

Several authors have made comprehensive studies of this interesting group of highly ornamented mosquitoes. Stone and Bohart [1944, Ent. Soc. Washington, Proc. **46** (8) : 205-225] reviewed the nine species of the group, including two new ones. Knight and Laffoon (1946, Am. Ent. Soc., Trans. **72**: 203-225) revised the Oriental species and added four new ones. Starkey and Webb (1946, Ent. Soc. Washington, Proc. **48**: 179) described one new species from the Palau Islands. Marks [1947, Univ. Queensland, Dept. Biol. 2 (5) : 1-66] in a general revision added four more species. Knight and Marks (1952, U. S. Nat. Mus., Proc. **101**: 513-574) listed 19 species in their "Group

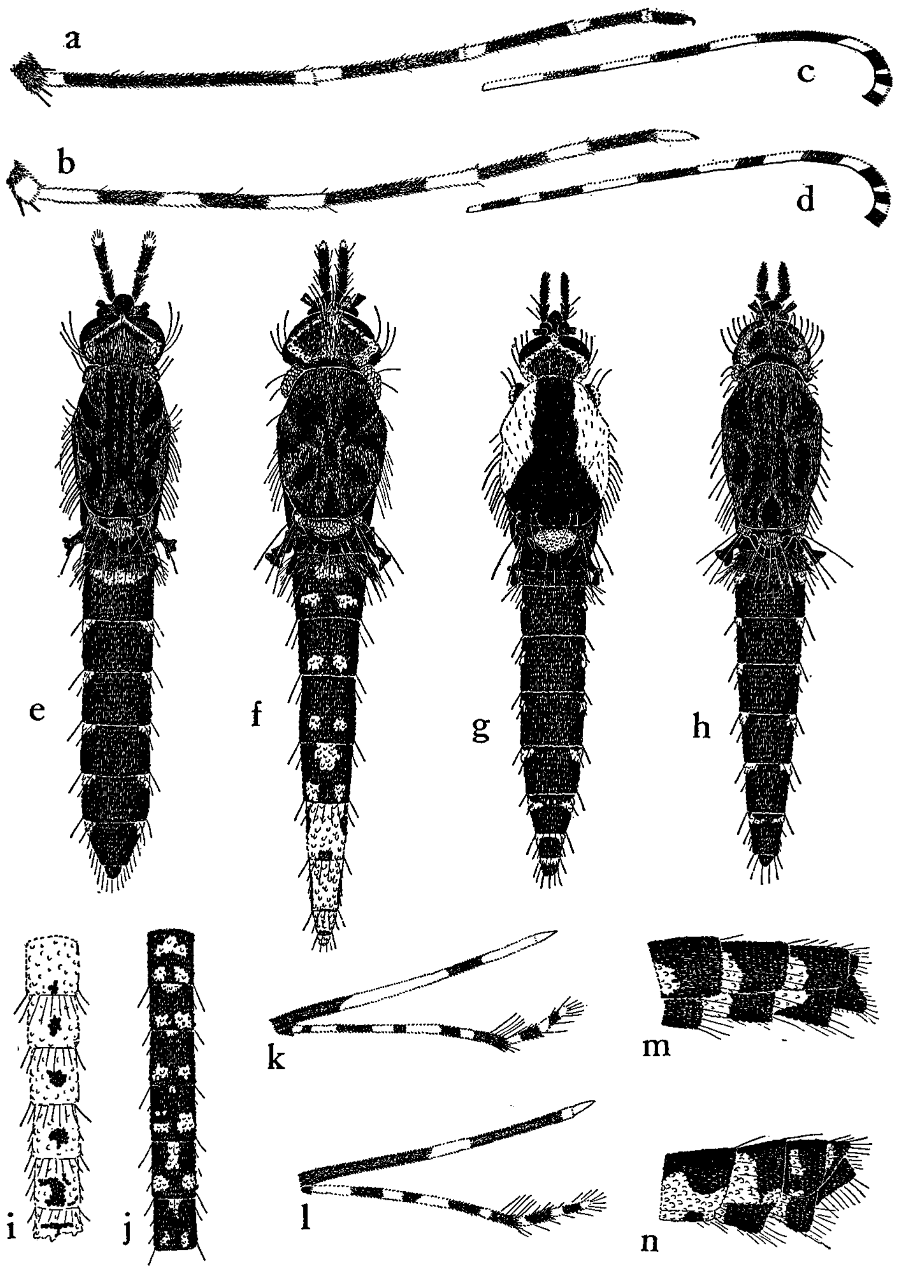

FIGURE 2.—*Aedes* (*Finlaya*), adults. **a, e,** *togoi: a,* hind tarsus, female, outer view; *e,* female body, dorsal view. **b, c, f, j, l,** *lewelleni: b,* hind tarsus, female, outer view; *c,* costal wing pattern, female; *f,* female body, dorsal view; *j,* tergites II-VII, male; *l,* proboscis and palpus, male, lateral view. **d, i, k,** *gressitti: d,* costal wing pattern, female; *i,* tergites II-VII, male; *k,* proboscis and palpus, male, lateral view. **g, n,** *dorseyi: g,* female body, dorsal view; *n,* abdominal segments V-VIII, female, lateral view. **h, m,** *savoryi: h,* female body, dorsal view; *m,* abdominal segments V-VIII, female, lateral view. (*h, k, m* after holotypes; *d* after paratype.)

arrangement of minute yellowish and dark scales; scutellar scales pale and broad on each lobe; pleuron with large patches of pale scales including some on paratergite; wing spotted with pale and dark broadened scales, arrangement on costa as in figure 2, *d*, second fork cell (M_1) longer than its stem; femora and tibiae spotted with black, white, and yellow, tarsi white-banded, hind tarsus about as in figure 2, *b* but with bands all more restricted, those on III and IV occupying about one-fourth of segment; integument of postscutellum dark brown, halter knob pale-scaled; dorsum of abdomen largely yellow with black basal spots or irregular bands, tergites II-VII with lateral subapical silvery spots continued onto the venter; sternites mostly pale except apically on V-VII where scales are outstanding.

Male: Palpus about as long as proboscis, white-banded as in figure 2, *k*; most basal dark costal spot small, one-half as long as following one. Abdomen more yellow than in female (fig. 2, *i*). Genitalia (fig. 3, *d*) with a large specialized seta at base of basistyle, a group of curved and very slender scales at middle of inner surface, dense tufts of bristles at inner base and inner apex; filament of claspette blade-like and sharply pointed.

Larva: Unknown.

Holotype, male (CM), Ngergoi (Garakayo) I., Palau Is., in *Pandanus* axil, Aug. 6, 1945, H. S. Dybas; paratype, female, Garakayo I., Aug. 1945, H. Dybas, C. Dorsey; metatype, male, Angaur I., Palau Is., Feb. 18, 1945, F. Gabriel, J. Sills, R. Baker. This specimen is one of the paratypes of *lewelleni* Starkey and Webb, deposited in the U. S. National Museum (US 58198).

DISTRIBUTION: Western Caroline Is. (Palau).

In the original description of *lewelleni* the authors apparently used more than one male specimen and inadvertently confused two species, one of which was *gressitti*. Their male genitalia illustration, though incomplete, shows the row of clublike setae and the blunt claspette characteristic of the *lewelleni* holotype. The description, on the other hand, refers to the claspette as "long, slender, spear shaped with a sharp point when viewed laterally." Perhaps this statement was based on the metatype male *gressitti* listed above. *Gressitti* belongs in the Papuan-Australian subgroup and runs to *knighti* Stone and Bohart in Marks' (1947, Univ. Queensland, Dept. Biol. 2(5): 1-66) key to adults. It differs from *knighti* in having a more extensively yellow proboscis and in the male genitalia by the sharp claspette, presence of a specialized basal seta, and absence of the large tuft of broadened scales.

Dedication: The species is named for J. L. Gressitt, who collected much of the material studied from the Palau group and who has given freely of advice during the preparation of this paper.

6. Aedes (Finlaya) hui Bohart, n. sp. (fig. 3, *e*).

Female: Length of wing 2.2 mm. Proboscis with median and apical yellow bands, median band occupying about two-fifths and apical one about one-tenth of proboscis, apical one narrowed beneath; palpus narrowly pale at apex; torus pale-scaled mesally; vertex with narrow yellowish scales at middle, flanked by dark broad ones and laterally with yellowish and then dark broad ones, some black upright scales medially; *apn* and *ppn* with broad pale scales, darker yellow on *ppn;* scutum with a rather diffuse arrangement of minute yellowish and dark scales; scutellar scales broad on all lobes, pale except for a large apical black patch on mid-lobe; pleuron with large patches of pale scales including a

The larva agrees with that of *lewelleni* in most of its features but is distinguished from it as well as from other known species by the six to nine branches of the upper head hair (5). According to Marks (1947) this hair is double or triple in *poicilius* (Theobald) and single in other species.

Dedication: The species is named for the collector, S. M. K. Hu in recognition of his contributions to our knowledge of mosquito control and distribution in the Pacific Area.

Group D

7. Aedes (Finlaya) togoi (Theobald). (Figures 2, *a, e*; 3, *a*; 4, *e-h.*)

Culicelsa togoi Theobald, 1907, Monograph Culicidae **4**: 379 (type female, U. S. Nat. Mus.).

Aedes togoi (Theobald), of Edwards, 1921, Bull. Ent. Res. **12**: 318.—Montschadsky, 1934, Stylops **3**: 247, figs. 1, 2.—Jackson, 1938, Chinese Med. Jour. **53**: 559.—Bohart and Ingram, 1946, NAVMED **1055**: 66, figs. 31, 66.—Hsiao and Bohart, 1946, NAVMED **1095**: 19, fig. 22.—La Casse and Yamaguti, 1950, Mosquito fauna of Japan and Korea, 161, plates 54, 55.—Knight and Marks, 1952, U. S. Nat. Mus., Proc. **101**: 529, 556.

Female: Agreeing essentially with description of *savoryi* except as follows: Palpus pale-tipped, torus with pale scales; scutal pale scales more numerous, paler, in a more diffuse pattern (fig. 2 *e*); fore- and mid-tarsi with narrow, largely basal, white bands, hind tarsus with joint bands (fig. 2, *a*). Abdominal tergal spots sometimes forming bands, especially on II-VI.

Male: Palpus with white joint bands, five-sixths as long as proboscis, terminal segments with short, sparse hairs; median area of vertex with some pale upright scales. Genitalia as in figure 3, *a*, claspette filament narrow.

Larva: Antenna with a small median tuft; clypeal spine long and slender; head hairs in a line toward front of head, many-branched, hair 4 small; mentum with 33 to 35 teeth. Pronotal hairs weak, 1 and 3 double. Terminal abdominal segments as in figure 3, *d*; pecten with 17 to 22 teeth; lateral hair of anal segment single and strong, inserted outside plate; gills globular.

Biology: Larvae breed in fresh to highly saline water near the seacoast. They are particularly to be found in rock pools and artificial containers of all sorts. In large cement cisterns larvae will remain several feet below the surface for many minutes, if disturbed. Adult females will enter habitations to bite at night and may be serious pests when sufficiently numerous. Omori and Fujii (1953, Yokohama Med. Bull. **4**: 23-31), using a man-baited trap, obtained 2,360 female *togoi* in six collections on the island of Oshima, Honshu, Japan. Feeding peaks were observed a few hours after sunset and just after sunrise. It is under suspicion as a vector of filariasis and Japanese B encephalitis in Japan and the Soviet Far East (Bohart and Ingram, 1946).

DISTRIBUTION: East coast of Siberia, Japan, China, Ryukyus, and Iwo

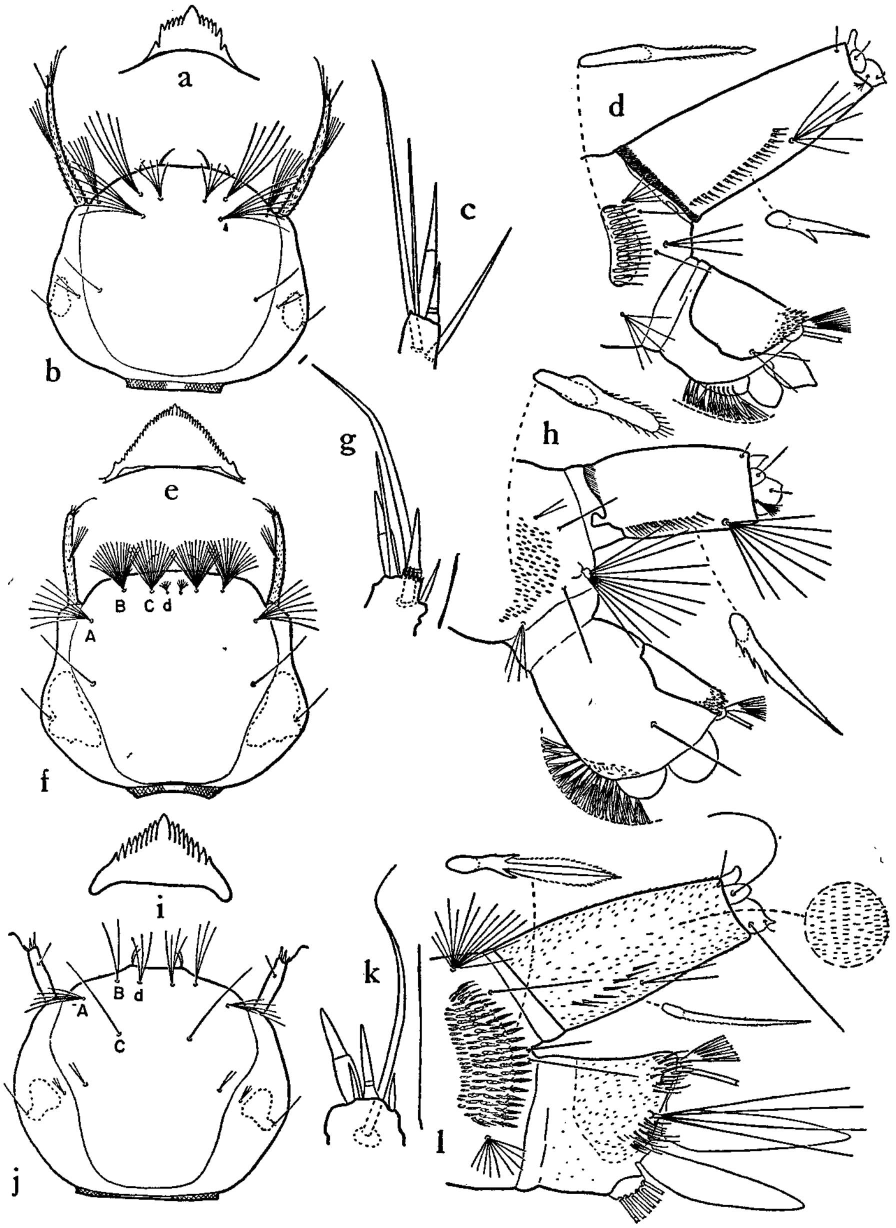

FIGURE 4.—*Aedes* (*Finlaya*), fourth stage larvae. **a-d**, *dorseyi*: *a*, mentum; *b*, head; *c*, enlargement of right antennal tip; *d*, posterior segments. **e-h**, *togoi*: *e*, mentum; *f*, head; *g*, enlargement of right antennal tip; *h*, posterior segments. **i-l**, *lewelleni*: *i*, mentum; *j*, head; *k*, enlargement of right antennal tip; *l*, posterior segments.

Dedication: The species is named for the American sailor, Nathaniel Savory, who colonized the Bonin Islands in 1830.

Subgenus **Stegomyia** Theobald

Edwards (1932, Genera Insectorum, Dipt. **194**: 1-258) divided the subgenus *Stegomyia* into four groups. The subsequent discovery of many new species and much additional information led to an expansion into five groups by Knight and Roseboom (1946, Biol. Soc. Washington, Proc. **59**: 83-98) and further modification through the introduction of subgroups by Knight and Hurlbut (1949, Washington Acad. Sci., Jour. **39**: 20-34) and Knight and Hull (1952, Pacific Sci. **6**: 157-189). Now it appears that a further expansion is necessary and I suggest that group F should be set up as the *pandani* group, and G as the *maehleri* group. The arrangement would then consist of seven groups as follows:

Group A. (*aegypti* group). Scutum with a lateral crescent-shaped, oval or rounded patch of white scales in front of scutal angle; with more or less distinct traces of one or two median pale lines; a supra-alar silvery or rarely yellowish scale patch present but no long lateral border of pale scales. Dististyle broader medially than distally, appendage near apex; paraproct with a prominent mesal ventral arm basally. Larva with *osc* single to triple, rarely quadruple. Represented in Micronesia by *aegypti*.

Group B. (*w-alba* group). Scutum with patches of white or yellow scales but no median white line nor lateral pale line from wing base to scutal angle. Dististyle appendage near apex, if present. Paraproct without vertical arm near base except in *desmotes* (Giles). Larva with pronotal hair 3 usually few-branched (not in *meronephada*), *osc* usually single. Not represented in Micronesia.

Group C. (*scutellaris* group). Scutum with conspicuous white median line, but without large white patches, no continuous lateral pale line from wing base to scutal angle. Dististyle long and slender, broader near apex than at middle, appendage near apex. Larva with *osc* single or rarely double; pronotal hair 3 with few branches. Represented in Micronesia by *albopictus, dybasi, guamensis, hakanssoni, hensilli, marshallensis, palauensis,* and *scutoscriptus*.

Group D. (*vittatus* group). Scutum with 4 or 6 small white dots. Lower mesepimeral bristles present. Anterior claws of female toothed. Dististyle greatly enlarged and with a curved, subterminal spine. Larva with spiculate antenna and a usually branched hair on shaft; comb in an irregular row; *osc* single. No Micronesian representatives.

Group E. (*albolineatus* group). Vertex with a median anterior diamond-shaped area of narrow white scales. Scutum with a narrow white median line, no continuous lateral pale line from wing base to scutal angle. Pleuron with a single broad longitudinal band of white scales from propleuron to upper mesepimeron. Dististyle appendage not near apex. Pronotal hair 3 of larva with few branches; *osc* single. No Micronesian representatives.

Group F. (*pandani* group). Scutum with yellowish scale markings including a narrow median line and a lateral line of narrow scales extending from wing base at least as far forward as scutal angle. Dististyle stout and bladelike, appendage near apex. Larva with pronotal hair 3 many-branched; *osc* with four or more branches; pecten in a curved row. Known species, which occur only in Micronesia, are *agrihanensis, neopandani, pandani, rotanus,* and *saipanensis*.

Group G. (*maehleri* group). Scutum with dark scales only. Dististyle stout and bladelike, appendage near apex. Larva with pronotal hair 3 long and double; *osc* triple. The only known species, *maehleri*, is Micronesian.

Group F (*pandani* group)

Female: Vertex with broad scales and a few short dark upright ones toward nape, a median whitish stripe extending between eyes, a very narrow pale margin to the eye ending in a large sublateral yellowish-white spot, a similar partially connected lateral spot; a pale yellowish ring of scales on torus; palpus white-tipped. Scutal scales dark brown with a median golden line, forked posteriorly, a thin submedian posterior line of similar hue, and another forming a lateral border as far anteriorly as scutal angle; scutal integument dark brown; scutellum with broad appressed pale scales on mid-lobe and dark ones on lateral lobe; *apn* with white appressed scales; *ppn* with similar scales below and golden narrow curved scales above; pleuron dark brown, sternopleuron with two large patches of white scales, one patch on mesepimeron and a line between wing base and spiracle; wing dark-scaled; femora mostly pale posteriorly, hind femur with a pale stripe, narrowed and more ventral toward apex where it is narrowly broken, knee spots on all femora yellowish; tibiae dark with some pale scales ventrally; white basal marks on fore- and mid-tarsals I and II, and on hind tarsals I-V.

Male: Palpus a little shorter than proboscis, segments with basal white marks. Genitalia with well-developed basal lobe bearing bristles of varying degree, dististyle stout and blade-like.

Pupa: Lateral hair of abdominal segment VIII with five or more branches; paddle fringed with long hair, terminal seta strong.

Larva: Head hair 7 single to triple, hair 5 single, hair 4 multiple and small. Thorax and abdomen with many stellate hairs; pronotal hair 1 multiple and long, 2 long and single, 3 shorter and multiple. Abdominal tergites with anterior submedian, posterior submedian, posterior sublateral, and lateral stellate hairs; comb in a row; pecten forming a somewhat curved line; first and fifth pentad hairs stellate, second and fourth single; anal saddle nearly complete; fan of about 10 hairs, all multiple; *osc* and *isc* both multiple.

The *pandani* group is evidently a superspecies without close relatives. It bears a superficial resemblance to some of the *aegypti* group but is probably more closely related to the *scutellaris* group. A possible relationship with one species of the latter, *scutoscriptus,* is suggested by the somewhat similar thoracic markings and the slightly curved pecten row in *scutoscriptus.*

The *pandani* group presents several interesting taxonomic features. In the adult the presence of numerous narrow scales on the scutellum of *rotanus* is remarkable in the subgenus. The double dististyle tooth of *saipanensis, rotanus,* and *agrihanensis* is likewise peculiar. However, this difference in genitalia between *pandani* and *rotanus* has not prevented the laboratory production of hybrids by females of the former mated to males of the latter (Bohart and Ingram, 1946). In the larvae the characteristic curved pecten row is best developed in *pandani* and least developed in *neopandani.* The divided clypeal spines of *pandani* and the usually double dorsal preapical siphon bristle of *neopandani* are also rather exceptional in *Stegomyia.* On the basis of male genitalia and larval characters, *saipanensis, rotanus,* and *agrihanensis* seem to form a closely knit subgroup. *Pandani* and *neopandani,* however, differ from each other in many respects, including scutal pattern and various larval features (figs. 6, *a, c*). The pupa differs from that of the *scutellaris* group in two obvious respects. First, abdominal hair A-VIII has five or more branches and second, the paddle fringe extends to near the base of the outer edge in-

with five to nine branches (average 6.7), flanked on either side by prominent spicules, smaller spicules distributed over most of saddle (fig. 6, *a*, inset); gills relatively slender, slightly unequal, longer pair usually longer than saddle; *osc* and *isc* with about four branches.

Biology: Larvae have been found only in leaf axils—commonly in those of

dog, rabbit, mouse, cow, and horse. Because of these habits it is a potential disease vector.

DISTRIBUTION: Guam, where it is widespread. The type locality as given by Stone (1939) is "Barrigada Area."

S. MARIANA IS. GUAM: Seventy-six males, 191 females, five pupae, 59 larvae, in axils of *Pandanus dubius* and *Pandanus fragrans*, 1936-1952, Swezey, Oakley, Gilbert, Webb, Hagen, Bohart, Gressitt, Ingram, Dybas, Reeves, Hu, Rudnick, Krauss.

11. Aedes (Stegomyia) neopandani Bohart, n. sp. (figs. 5, *c, f, j, o*; 6, *c, f*).

Agrees with the group characters and has the following specific ones:

Female: Length of wing 2.6 mm. Proboscis black. Median scutal stripe pale golden, about as broad as third flagellar segment, narrowing only slightly to a point opposite wing base; halter knob dark-scaled; hind tarsus with basal white bands on each segment as shown in figure 5, *c*, the bands complete except on I. Abdominal tergites II-VII with broad basal white spots, often divided on II and III, separated from laterobasal spots which are hardly visible in dorsal view; venter mostly white on II-IV, broadly white basally on V-VII.

Male: White band on hind tarsal V narrowly interrupted above (complete in some paratypes). Abdominal tergite II dark medially, median spot divided on III and IV, attached to lateral spot on IV and V, VIII with lateral spot only. Dististyle (fig. 5, *o*) with apex curved and sclerotized, single tooth slender and sharp, dististyle 5.6 times as long as its greatest breadth.

Pupa: Tergites II-IV with contrasting, transverse, basal black bands (fig. 5, *j*). Lateral hair of segment VIII with about seven branches from base and 15 terminal branchlets; longest hair of paddle fringe about one-eighth of paddle rib, terminal bristle about one-half of paddle rib.

Larva (description based on 28 paratypes): Antennal hair inserted at apical two-fifths to one-fourth of antennal shaft, clypeal spine slender and single; head hair 6 usually double (91 percent), mentum with about 21 teeth (fig. 6, *f*). Posterior submedian hair of abdominal tergites multiple but much weaker than anterior submedian; all stellate hairs pale, comb (fig. 6, *c*) of nine to 18 scales (average 13); third pentad hair with five to nine branches; siphon rather rectangular in outline, with nine to 17 pecten teeth, each tooth with one large denticle and one or two minute ones; siphon tuft of two to four branches (average three), inserted at or slightly beyond distal one-third of tube; dorsal preapical bristle usually double (82 percent), lateral hair of anal segment about one-half as long as siphon tube, with four to eight branches (average six); a few spicules dorsal to lateral hair; gills unequal, longer pair about as long as saddle; *osc* with about six branches, *isc* with about five branches.

Holotype, male (US), Mt. Tapotchau, Saipan, S. Mariana Is. in *Pandanus* axil, June 29, 1951, R. M. Bohart. Paratypes, two males, three females, 28 larvae, 11 pupae and skins, same data as holotype; three females, southern Saipan, biting, Nov. 12-17, 1944, H. S. Dybas; two females, Saipan, biting, Jan. 14, 1949; one male, Saipan, Nov. 17, 1945. Metatypes, seven females, Marpo Valley, Tinian Is., biting, Mar. 22, 1945, Dybas.

Biology: Larvae are known only from *Pandanus* and taro axils where they are associated with *saipanensis*. Of the 15 female specimens available for study, 12, representing two collections, were taken biting man during the day.

Group F (*pandani* group)

Female: Vertex with broad scales and a few short dark upright ones toward nape, a median whitish stripe extending between eyes, a very narrow pale margin to the eye ending in a large sublateral yellowish-white spot, a similar partially connected lateral spot; a pale yellowish ring of scales on torus; palpus white-tipped. Scutal scales dark brown with a median golden line, forked posteriorly, a thin submedian posterior line of similar hue, and another forming a lateral border as far anteriorly as scutal angle; scutal integument dark brown; scutellum with broad appressed pale scales on mid-lobe and dark ones on lateral lobe; *apn* with white appressed scales; *ppn* with similar scales below and golden narrow curved scales above; pleuron dark brown, sternopleuron with two large patches of white scales, one patch on mesepimeron and a line between wing base and spiracle; wing dark-scaled; femora mostly pale posteriorly, hind femur with a pale stripe, narrowed and more ventral toward apex where it is narrowly broken, knee spots on all femora yellowish; tibiae dark with some pale scales ventrally; white basal marks on fore- and mid-tarsals I and II, and on hind tarsals I-V.

Male: Palpus a little shorter than proboscis, segments with basal white marks. Genitalia with well-developed basal lobe bearing bristles of varying degree, dististyle stout and blade-like.

Pupa: Lateral hair of abdominal segment VIII with five or more branches; paddle fringed with long hair, terminal seta strong.

Larva: Head hair 7 single to triple, hair 5 single, hair 4 multiple and small. Thorax and abdomen with many stellate hairs; pronotal hair 1 multiple and long, 2 long and single, 3 shorter and multiple. Abdominal tergites with anterior submedian, posterior submedian, posterior sublateral, and lateral stellate hairs; comb in a row; pecten forming a somewhat curved line; first and fifth pentad hairs stellate, second and fourth single; anal saddle nearly complete; fan of about 10 hairs, all multiple; *osc* and *isc* both multiple.

The *pandani* group is evidently a superspecies without close relatives. It bears a superficial resemblance to some of the *aegypti* group but is probably more closely related to the *scutellaris* group. A possible relationship with one species of the latter, *scutoscriptus,* is suggested by the somewhat similar thoracic markings and the slightly curved pecten row in *scutoscriptus.*

The *pandani* group presents several interesting taxonomic features. In the adult the presence of numerous narrow scales on the scutellum of *rotanus* is remarkable in the subgenus. The double dististyle tooth of *saipanensis, rotanus,* and *agrihanensis* is likewise peculiar. However, this difference in genitalia between *pandani* and *rotanus* has not prevented the laboratory production of hybrids by females of the former mated to males of the latter (Bohart and Ingram, 1946). In the larvae the characteristic curved pecten row is best developed in *pandani* and least developed in *neopandani.* The divided clypeal spines of *pandani* and the usually double dorsal preapical siphon bristle of *neopandani* are also rather exceptional in *Stegomyia.* On the basis of male genitalia and larval characters, *saipanensis, rotanus,* and *agrihanensis* seem to form a closely knit subgroup. *Pandani* and *neopandani,* however, differ from each other in many respects, including scutal pattern and various larval features (figs. 6, *a, c*). The pupa differs from that of the *scutellaris* group in two obvious respects. First, abdominal hair A-VIII has five or more branches and second, the paddle fringe extends to near the base of the outer edge in-

stead of the basal one-third only. Another feature of the group is the strong development of hair C-II.

10. Aedes (Stegomyia) pandani Stone (figs. 5, *h, l, q*; 6, *a, h*).

Aedes pandani Stone, 1939, Ent. Soc. Washington, Proc. **41**: 162, fig. 1A (type female, U. S. Nat. Mus.).—Swezey, 1942, B. P. Bishop Mus., Bull. **172**: 199.—Stone, 1945, Ent. Soc. Washington, Proc. **47**: 68.—Bohart and Ingram, 1946, NAVMED **1055**: 38, figs. 25, 63.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 60, pls. 17-18.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31**: 641.—Hull, 1952, U. S. Armed Forces Med. Jour. **3**: 1294.— Bailey and Bohart, 1952, Jour. Economic Ent. **45**(6): 947, 951.

Female: Proboscis black. Median scutal golden stripe gradually narrowed posteriorly, very narrow opposite wing base; fore- and mid-tarsal III with a few white basal scales, hind tarsals I and V with white bands interrupted on inner surface; abdominal dorsum mostly dark (fig. 5, *h*), with subbasal white spots on VI, V, and sometimes on IV, separate from basoventral spots, VII with spots or a band connected ventrally; halter knob dark-scaled.

Male: Hind tarsal V sometimes all dark, band on IV interrupted, dististyle (fig. 5, *q*) about six times as long as its greatest breadth, with apex strongly sclerotized and with tooth blunt but simple.

Pupa: Marked as in figure 5, *l*. Lateral hair of segment VIII with seven or eight branches from base and with 10 to 15 terminal branchlets; longest hair of paddle fringe about one-fourth as long as paddle rib, terminal bristle about three-fifths of rib. The paddle and respiratory trumpet have been figured by Bohart and Ingram (1946).

Larva (based on 32 specimens from Guam): Antennal hair inserted at middle to apical two-fifths of shaft; clypeal spine with two to six branches from near base (fig. 5, *h*); head hair 6 occasionally double (8 percent); stellate hairs of body pale-colored; comb (fig. 6, *a*) of 14 to 23 spinelike scales (average 18), third pentad hair double to quadruple; siphon with 14 to 28 spinelike pecten teeth (average 21) in a strongly curved row; siphon tuft double to quadruple, inserted somewhat beyond middle of tube (0.55-0.65); dorsal preapical bristle rarely double; lateral hair of anal segment longer than siphon tube, with five to nine branches (average 6.7), flanked on either side by prominent spicules, smaller spicules distributed over most of saddle (fig. 6, *a*, inset); gills relatively slender, slightly unequal, longer pair usually longer than saddle; *osc* and *isc* with about four branches.

Biology: Larvae have been found only in leaf axils—commonly in those of *Pandanus*, occasionally in those of taro. Adults bite readily during the day from dawn through dusk in sun and shade. They will enter buildings to bite and have been observed taking blood under dim light as late as 10:00 p.m. This species is the worst pest on Guam in jungle areas, but the extensive clearing during and following World War II has restricted its abundance. On the other hand, this tendency has been somewhat offset by the increased number of *Pandanus* plants used for ornamental purposes. In spite of the apparently fixed habitat relationship, *pandani* was readily colonized by H. S. Hurlbut and larvae were reared on dried animal food sprinkled over open pans of tap water (Bohart and Ingram, 1946). The adults have been reported to feed on man,

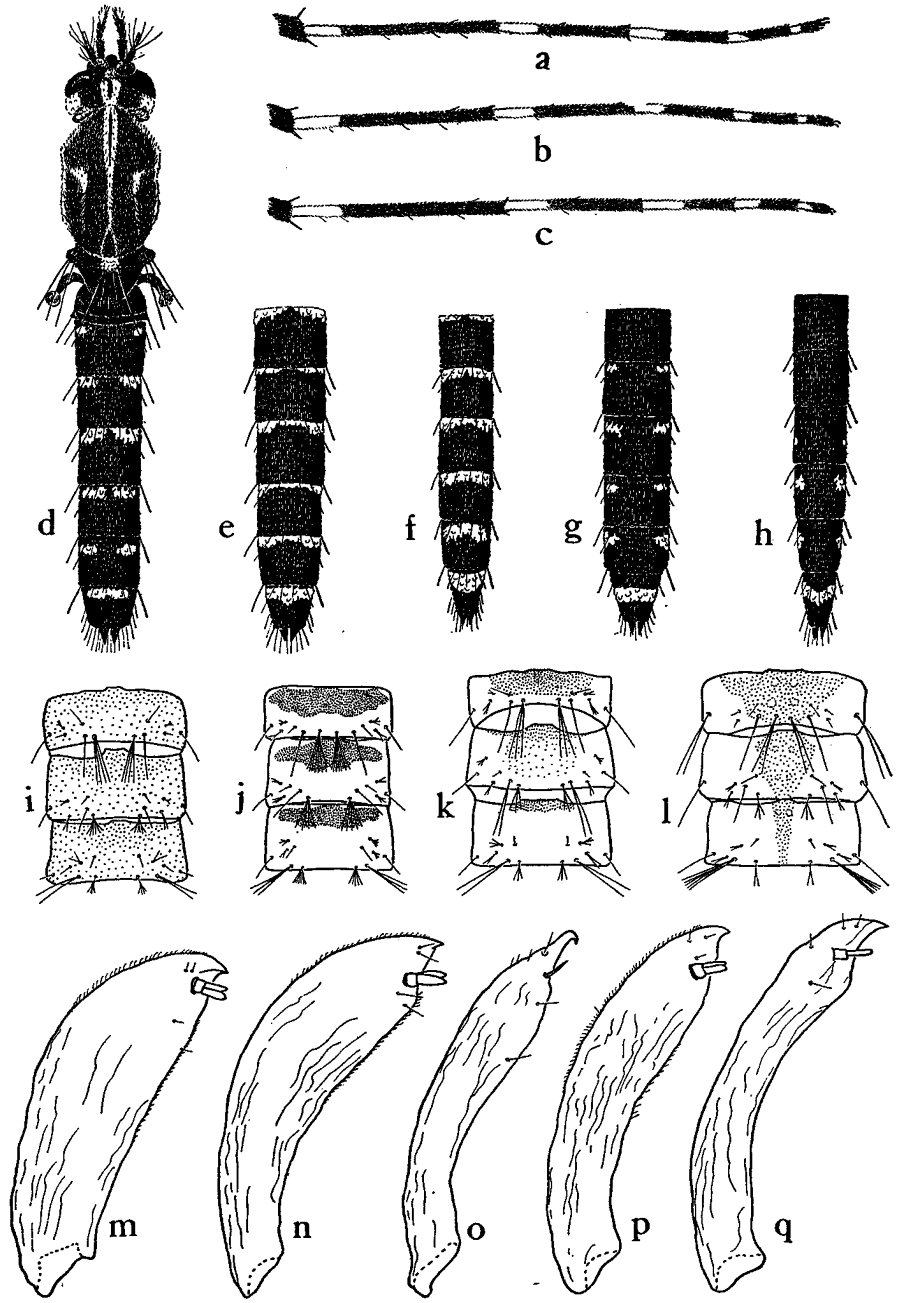

FIGURE 5.—*Aedes* (*Stegomyia*) *pandani* group, adults and pupae. **a, d, i, m,** *agrihanensis: a,* hind tarsus, female, outer view; *d,* female, dorsal view; *i,* pupal tergites II-IV; *m,* dististyle. **b, e, n,** *saipanensis: b,* hind tarsus, female, outer view; *e,* abdominal tergites, female; *n,* dististyle. **c, f, j, o,** *neopandani: c,* hind tarsus, female, outer view; *f,* abdominal tergites, female; *j,* pupal tergites II-IV; *o,* dististyle. **g, k, p,** *rotanus: g,* abdominal tergites, female; *k,* pupal tergites II-IV; *p,* dististyle. **h, l, q,** *pandani: h,* abdominal tergites, female; *l,* pupal tergites II-IV; *q,* dististyle. (*a, c, d, f, g, i, m* after paratypes.)

dog, rabbit, mouse, cow, and horse. Because of these habits it is a potential disease vector.

DISTRIBUTION: Guam, where it is widespread. The type locality as given by Stone (1939) is "Barrigada Area."

S. MARIANA IS. GUAM: Seventy-six males, 191 females, five pupae, 59 larvae, in axils of *Pandanus dubius* and *Pandanus fragrans,* 1936-1952, Swezey, Oakley, Gilbert, Webb, Hagen, Bohart, Gressitt, Ingram, Dybas, Reeves, Hu, Rudnick, Krauss.

11. Aedes (Stegomyia) neopandani Bohart, n. sp. (figs. 5, *c, f, j, o*; 6, *c, f*).

Agrees with the group characters and has the following specific ones:

Female: Length of wing 2.6 mm. Proboscis black. Median scutal stripe pale golden, about as broad as third flagellar segment, narrowing only slightly to a point opposite wing base; halter knob dark-scaled; hind tarsus with basal white bands on each segment as shown in figure 5, *c,* the bands complete except on I. Abdominal tergites II-VII with broad basal white spots, often divided on II and III, separated from laterobasal spots which are hardly visible in dorsal view; venter mostly white on II-IV, broadly white basally on V-VII.

Male: White band on hind tarsal V narrowly interrupted above (complete in some paratypes). Abdominal tergite II dark medially, median spot divided on III and IV, attached to lateral spot on IV and V, VIII with lateral spot only. Diststyle (fig. 5, *o*) with apex curved and sclerotized, single tooth slender and sharp, diststyle 5.6 times as long as its greatest breadth.

Pupa: Tergites II-IV with contrasting, transverse, basal black bands (fig. 5, *j*). Lateral hair of segment VIII with about seven branches from base and 15 terminal branchlets; longest hair of paddle fringe about one-eighth of paddle rib, terminal bristle about one-half of paddle rib.

Larva (description based on 28 paratypes): Antennal hair inserted at apical two-fifths to one-fourth of antennal shaft, clypeal spine slender and single; head hair 6 usually double (91 percent), mentum with about 21 teeth (fig. 6, *f*). Posterior submedian hair of abdominal tergites multiple but much weaker than anterior submedian; all stellate hairs pale, comb (fig. 6, *c*) of nine to 18 scales (average 13); third pentad hair with five to nine branches; siphon rather rectangular in outline, with nine to 17 pecten teeth, each tooth with one large denticle and one or two minute ones; siphon tuft of two to four branches (average three), inserted at or slightly beyond distal one-third of tube; dorsal preapical bristle usually double (82 percent), lateral hair of anal segment about one-half as long as siphon tube, with four to eight branches (average six); a few spicules dorsal to lateral hair; gills unequal, longer pair about as long as saddle; *osc* with about six branches, *isc* with about five branches.

Holotype, male (US), Mt. Tapotchau, Saipan, S. Mariana Is. in *Pandanus* axil, June 29, 1951, R. M. Bohart. Paratypes, two males, three females, 28 larvae, 11 pupae and skins, same data as holotype; three females, southern Saipan, biting, Nov. 12-17, 1944, H. S. Dybas; two females, Saipan, biting, Jan. 14, 1949; one male, Saipan, Nov. 17, 1945. Metatypes, seven females, Marpo Valley, Tinian Is., biting, Mar. 22, 1945, Dybas.

Biology: Larvae are known only from *Pandanus* and taro axils where they are associated with *saipanensis.* Of the 15 female specimens available for study, 12, representing two collections, were taken biting man during the day.

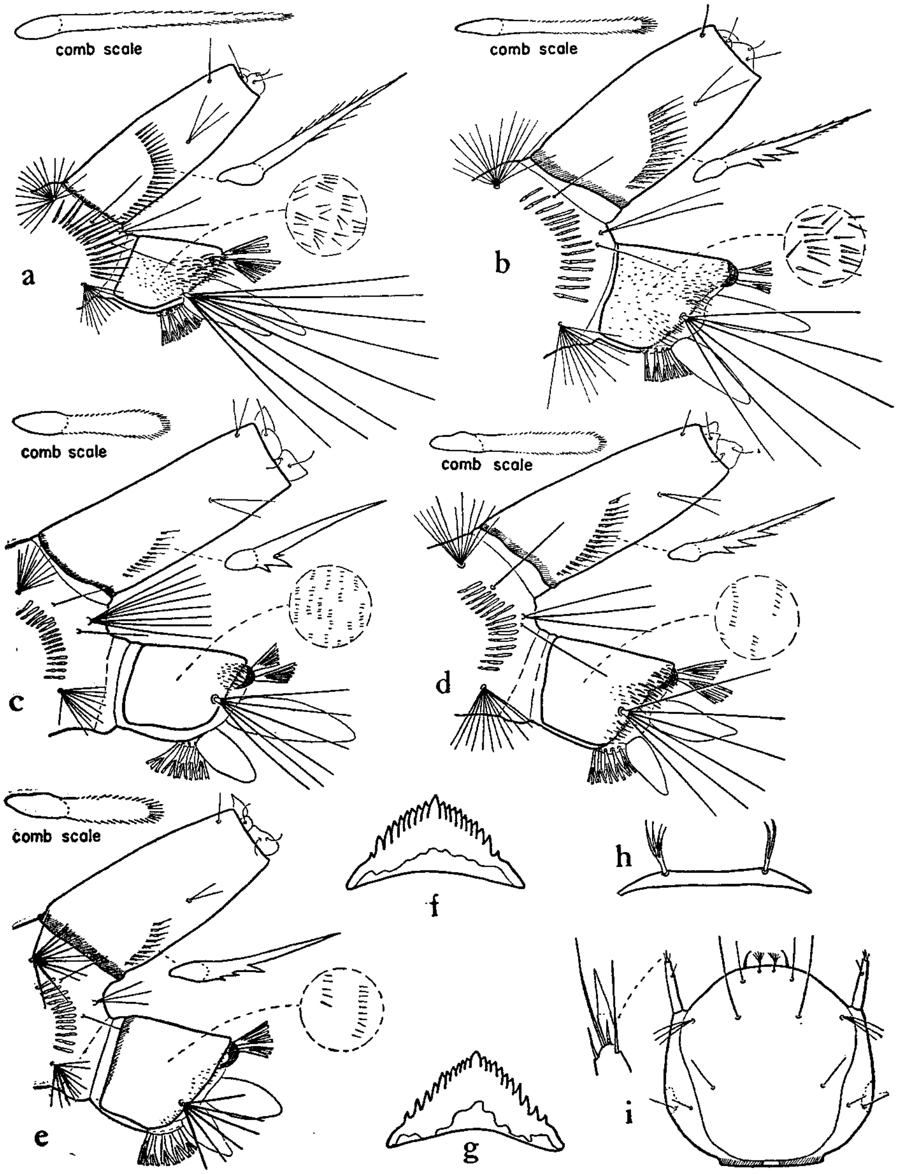

FIGURE 6.—*Aedes* (*Stegomyia*) *pandani* group, fourth stage larvae. **a**, **h**, *pandani*: *a*, posterior segments; *h*, clypeus. **b**, *rotanus*, posterior segments. **c**, **f**, *neopandani*: *c*, posterior segments; *f*, mentum. **d**, *saipanensis*, posterior segments. **e**, **g**, **i**, *agrihanensis*: *e*, posterior segments; *g*, mentum; *i*, head. (*c*, *e*, *f*, *g*, *i* after paratypes.)

halter knob mostly pale-scaled, fore- and mid-tarsi with complete white basal bands on I and II, hind tarsus with basal white bands on each segment (fig. 5, *a*), interrupted beneath on I. Abdominal tergites with laterobasal white spots on II-V, similar subbasal lateral spot on VI, and a subbasal band on VII, dorsal markings separated from large, basoventral spots; venter white on I-IV, broadly white basally on V and VI, with a median white band on VII.

Male: White band on hind tarsals IV and V narrowly interrupted. Dististyle (fig. 5, *m*) 3.2 times as long as its greatest breadth, with a stout double subapical tooth.

Pupa: Integument rather generally brown-stained but without contrasting basal markings on abdominal tergites (fig. 5, *i*). Lateral hair of segment VIII with seven or eight branches from base, one or two of these sometimes divided; longest hair of paddle fringe about one-fifth of paddle rib, terminal bristle slightly over one-half of paddle rib.

Larva (description based on 50 specimens): Antennal hair inserted at middle to apical seven-tenths of antennal shaft; clypeal spine slender and single; head hair 6 single, mentum with about 21 teeth (fig. 6, *g*). Stellate abdominal hairs relatively short, stout, and dark; comb (fig. 6, *e*) of 10 to 14 scales (average 12.5); third pentad hair double to quadruple (average branches 2.9); siphon with nine to 20 pecten teeth (average 13.5), each tooth with one large denticle and one or two minute ones; siphon tuft double or triple, inserted near middle of siphon tube (0.45-0.60); dorsal preapical bristle single; lateral hair of anal segment one-third to one-half as long as siphon tube, with four to seven (average 5.6) stout branches; a row of stout spicules toward margin of saddle dorsal to lateral hair and a few small spicules posterior to it; gills unequal, longer pair shorter than saddle; *osc* with about four branches, *isc* with about five branches.

Holotype, male (US), southwest village, Agrihan, N. Mariana Is., coconut tree hole, June 29, 1951, R. M. Bohart; paratypes, 20 males, 23 females, 39 pupae or skins, 45 larvae, same data as holotype; metatypes, eight larvae, Agrihan, Aug. 4, 1945, D. Borror, Holden.

Biology: Larvae have been collected in coconut tree holes. Adult habits are unknown.

DISTRIBUTION: Agrihan I., N. Mariana Is. The type collection was taken about one-fourth mile south of the southwest village.

Although closely related to *saipanensis,* tarsal differences occur in adults of both sexes (fig. 5, *a, b*) and the male dististyles are somewhat different. In the larvae, *agrihanensis* has generally stouter, shorter, and darker stellate tufts; a more anteriorly placed siphon hair; a smaller third pentad hair; and greatly reduced posterior spiculation on the saddle.

Group G (*maehleri* group)

15. Aedes (Stegomyia) maehleri Bohart, n. sp. (fig. 7, *g-i*).

Male: Length of wing 2.0 mm. Palpus broken across "long" segment opposite middle of proboscis (white-banded and two thirds as long as proboscis in paratype), proboscis all dark; median area of vertex with a double row of broad silvery scales extending between eyes, flanked by broad dark ones and a lateral silvery spot; torus bare, antennae missing (apparently normal in paratype). Scutum with brown integument and many small darker narrow scales (fig. 7, *g*); *apn* with broad silvery scales; *ppn* with a lower patch of small, broad silvery scales; scutellum with many silvery broad scales on mid-lobe, broad dark ones on lateral lobe; pleuron with five scale patches, one each on propleuron, paratergite, and mesepimeron, two on sternopleuron; wing and halter knob dark-scaled; femora mostly pale posteriorly except for a dorsal line, mostly dark in front except for a ventral line on hind femur, ending indistinctly at distal three-fourths, small white knee spots

present; tibiae dark; fore and mid-tarsi with basal white marks on I and II, hind tarsus with narrow bands on all segments, those on IV and V hardly distinguishable, those on I-III covering about one-fourth of segments. Abdominal dorsum with slightly subbasal lateral spots on II-V (VI and following missing) those on IV and V narrowly prolonged inward to form incomplete bands; sternites with broad white basal bands.

Female: Unknown.

Larva (data based on 13 paratypes). Antennal shaft not spiculate, bristle inserted beyond middle, apical setae as in figure 7, *h;* clypeal spine slender; head hairs 5 and 6 single, 4 in front of 6 and double to quadruple; mentum with 17 to 21 teeth (fig. 7, *h*). Pronotal hair 1 short and triple, 3 long and double; thorax and abdomen with numerous short stellate hairs with five or fewer branches. Comb of 10 to 12 stout scales in a row (fig. 7, *i*); first pentad with three or four branches, third double, fifth with four to seven; siphon somewhat pilose, with a long row of three or four pecten teeth followed about at distal three-fourths by a single or double hair; saddle nearly complete, posteriorly with long spicules, mostly dorsal to the large lateral hair which has four to six branches; eight multiple hairs in anal fan; gills longer than saddle, equal; *isc* and *osc* triple and long.

Pupa: Trumpet with closed part 1.9 times as long as distal open part. Float hair with five somewhat fringed branches; C-II short and single; B-II long, single, and strong. A-VIII three-fourths as long as paddle and three-branched; paddle short, broadly rounded at apex, with a conspicuous fringe from proximal one-third of outer margin to distal one-third of inner margin, terminal seta 0.48 times as long as paddle rib.

Holotype, male (US), Guror, Yap, Caroline Is., pitcher plant, Mar. 1, 1949, K. L. Maehler; paratypes, three larvae, same data as holotype; one male dissected from pupa, and seven larvae, Yap Is., pitcher plant, Sept. 1952, N. L. H. Krauss; three larvae, Yap, Nov. 12, 1946, D. G. Frey.

DISTRIBUTION: Western Caroline Is. (Yap).

The dark-scaled scutum, stout and bladelike dististyle, and peculiar larvae immediately set this species apart. As previously indicated (p. 32), a new group, G, is proposed for it. The only other Micronesian species known to develop in pitcher plants is *Aedes dybasi* from Palau. The two are entirely different but the larvae show a similar tendency toward a reduction of the pecten and many of the body bristles. The pupae, also, tend toward a reduction of bristle branches.

Group A (*aegypti* group)

16. Aedes (Stegomyia) aegypti (Linnaeus). (Figure 7, *a.*)

Culex aegypti Linnaeus, 1762, IN Hasselquist's Reise nach Palestine, 470.

(For further synonymy see Edwards, 1932, Genera Insectorum, Dipt. **194**: 161.—Barraud, 1934, Fauna India, Dipt. **5**: 221.)

(For descriptions and figures see Barraud, 1934, loc. cit.—Bohart and Ingram, 1946, NAVMED **1055**: 6.—Yamaguti and La Casse, 1950, Mosquito Fauna of Guam, 42.—Knight and Hull, 1952, Pacific Science **6**: 167.)

(For Micronesian references see Esaki, 1941, Sixth Pacific Sci. Congr., Berkeley, Proc. **4**: 414.—Swezey, 1942, B. P. Bishop Mus., Bull. **172**: 199.—Bohart and Ingram, 1946, loc. cit.—Yamaguti and La Casse,

1944. Apparently specimens have not been found since control measures of that time were put into effect. Similarly, no recent records are available for Rota and Saipan.

BONIN IS. Chichi Jima: Two males, three females, Aug. 1916, Daido.

VOLCANO IS. Iwo Jima: One male, Aug. 1920, Saito.

S. MARIANA IS. Saipan: One male, one female, Matansha-Banaderu, July 1939, Esaki. Tinian: Northwest, four larvae, in wooden bucket, Aug. 1944, Bailey, Cott. Rota: West end, one female, in artificial container, Oct. 1945, Bohart and Ingram. Guam: Four males, eight females, one pupa, 15 larvae, Pt. Oca, 1945, laboratory colony at Navy Medical Research Unit 2.

TRUK. Wena (Moen): Two males, two females, Dec. 1945, Ingram.

PONAPE. Colonia: One male, Jan. 1938, Esaki.

KUSAIE. Lelo: One male, Dec. 1937, Esaki.

WAKE. One female, Dec. 1947, Rosen.

MARSHALL IS. Kwajalein: Five males, two females, in iron drum, June 1944, Enke. Likiep: Five larvae, July 1948, Bullock. Arno: One male, three females, Ine I., June 1950, Usinger. Majuro: Majuro I., June 1950, Usinger.

Aedes aegypti belongs to the so-called "African" species of the subgenus, group A (*aegypti* group), the characters of which are listed on page 32. The distinctive scutal markings of the adult and the large pleural spines in the larva distinguish this species from all others in the area under consideration. The pupa is distinctive in that the paddle has a serrate margin and a short, simple terminal seta. The abdominal chaetotaxy of the pupa has been given in a comparative way by Penn (1949, Jour. Parasitology **33**: 43-50).

Group C (*scutellaris* group) subgroup I

Female: Vertex with broad scales, dark except for median silvery stripe which extends between eyes, a sublateral and a lateral silvery spot; torus and apex of palpus marked with silvery scales; proboscis dark. Scutum with a median silvery stripe, very much narrowed and forking posteriorly, a faint submedian posterior line, a group of silvery scales over wing base connecting with a line across upper part of pleuron which extends onto *apn;* pleuron with another line across upper part of sternopleuron and mesepimeron, two other spots on these sclerites and prominent coxal spots (fig. 8, *g, n*); scutellum with broad silvery scales on all lobes (except *hakanssoni*), some appressed black scales at apex of mid-lobe; fore- and mid-femora with a posterior line of pale scales; hind femur with basal half pale posteriorly, variously marked in front; knee spots present on all femora; tibiae mostly dark; tarsal white markings basal. Abdominal sternites mostly pale on I-IV, pale basally on V-VI, medially on VII, VIII dark.

Male: Palpus slightly shorter than proboscis, segments with basal white marks. Abdominal segment VIII mostly white-scaled above.

Pupa: Paddle with rather long, abundant, fine hair covering about two-thirds of the outer margin and one-half the inner margin; hair A-VII with one to three strong branches; hair C-II branched.

Larva: Head shaped about as in figure 9, *b* (except *dybasi*); antenna with small single hair about at middle, clypeal spine slender, head hair 5 single, hair 6 usually single (except *scutoscriptus*), hair 4 multiple. Pronotal hairs 1 and 3 usually double or triple (except *dybasi*), 2 single. Comb of stout scales in row. Second and fourth pentad hairs single; siphon hair inserted at about middle of tube (except *palauensis*); saddle encircling more than three-fourths of anal segment (except *dybasi*), minutely spiculate along posterior margin; *osc* single (except *hakanssoni*), *isc* double to quadruple (except *dybasi*); the most posterior anal fan hairs single (except in *hakanssoni*).

Knight and Hull (1952) characterize the subgroup (I) by the partially subbasal abdominal tergal markings, the slender median scutal line, the absence of postspiracular scales, and the arrangement of the pleural markings into two well-defined longitudinal bands. There are currently 20 species and subspecies in the subgroup. Seven of these occur in Micronesia, but only one to an individual island except in the Palaus, where three or four may occur, and on Truk, where there are two. The subgroup is remarkably homogeneous except for *scutoscriptus, hakanssoni,* and *gurneyi* in which the pleural pattern is scarcely linear. Possibly *gurneyi* should have a subgroup of its own, and the other two might be placed in still another subgroup. On the other hand it might be argued that subgroup I contains *gurneyi* and two superspecies represented by *scutoscriptus* and *scutellaris.* This latter line of reasoning is here being followed.

In an extensive review of the subgroup, Marks (1954) has given comparative sketches of several morphological features. Also, she has presented a lengthy discussion of the relative value of taxonomic characters in current use. In the *scutellaris* superspecies the most obvious specific differences lie in the tarsal markings. The hind femoral and scutal patterns are likewise important and abdominal markings, though variable, have some significance. Most diagnostic of all are the basal lobes of the basistyle in the male genitalia. In dealing with these, care must be taken to study lateral dissected views as well as the oblique, undissected views. Usually, the lateral views are much more diagnostic, but in the case of *marshallensis* the oblique view is usually figured (fig. 10, *e*). The larvae do not seem to have subgroup characters, but details of the comb, pecten, and lateral hair of the anal segment are generally useful in distinguishing species. However, larvae of *hensilli* and *scutellaris* appear to be practically identical with those of *albopictus* which is in a different subgroup. By far the most distinctive larva is that of *dybasi* (fig. 9, *a, e*), and its peculiarities can be ascribed to its habitat in *Nepenthes.*

The *scutoscriptus* superspecies (including *hakanssoni*) is distinguished by the presence of a more or less developed lateral bowed line on the scutum in addition to the median stripe. The pleural markings can hardly be called linear but are more nearly so than in the *albopictus* group. Rather remarkable in the larvae are the tendencies toward a curved pecten row and double head hair 6 in *scutoscriptus* and the double posterior fan hairs and *osc* in *hakanssoni.*

The pattern of endemism, shown by the subgroup elsewhere is clear in Micronesia also. The Gilberts, Marshalls, and extreme eastern Carolines are inhabited by *marshallensis*. Ponape has *hakanssoni*. Truk has *scutoscriptus* and is the eastern point of the range of *hensilli* which extends westward over the rest of the Carolines. Babelthuap and Koror harbor *dybasi*, and Ngergoi and Peleliu have *palauensis*. Possibly as a result of wartime introduction, *scutellaris* extends its range from Melanesia north into the Palaus. Finally, *guamensis* is peculiar to the Marianas.

17. Aedes (Stegomyia) scutoscriptus Bohart and Ingram (fig. 7, *b, e, f*).

Aedes scutoscriptus Bohart and Ingram, 1946, NAVMED **1055**: 27, fig. 27 (type male, U. S. Nat. Mus.).—Knight and Hurlbut, 1949, Washington Acad. Sci. Jour. **39**: 27.—Marks, 1954, Bull. Brit. Mus., Ent. **3**: 352, pl. 18.

Female: Scutum with a bowed line of silvery scales with a yellowish tinge (fig. 7, *f*); pleural silvery markings not so obviously linear as in most others of subgroup; hind femur in front with a pale ventral line terminating short of knee spot; fore- and mid-tarsi with basal white marks on I and II; hind tarsus with basal white marks covering about one-fourth of I, one-third of II, nearly one-half of III, and all of V, a few pale scales at base of IV, basal white marks broadly interrupted beneath on I and V, narrowly on III. Abdominal tergites with laterobasal white spots continued to sides of dorsum of II-VII as subbasal spots.

Male: Hind tarsal III with white basal band complete. Genitalia as in figure 7, *b*.

Larva (data based on 50 specimens from Truk Islands): Head hair 6 double or rarely single. Comb of five to eight stout scales (fig. 7, *e*), well fringed and occasionally multiple (10 percent of specimens with one or more multiple scales); first and fifth pentads with two to five branches (average 3.5), third with three to seven (average 4.5); siphon with seven to 17 pecten teeth in a slightly curved row (average 10.6), each with a side tooth, followed by a hair with three or four branches; saddle bearing a double or rarely single hair (4 percent with hair single on one side of body), branches of double hairs about equal in length; gills large, slightly unequal, longer pair 1.5-2.5 times as long as saddle.

Pupa: The chaetotaxy is similar to that figured by Knight and Hurlbut (1949) for *hakanssoni*.

Biology: Larvae have been found in tree holes and in artificial containers. Adults have not been observed in nature (Bohart and Ingram, 1946, p. 28).

DISTRIBUTION: Known only from the Truk Islands of Moen (type locality), Uman, Utot, Falo, and Tol.

TRUK. Eight males, eight females, two pupal skins, 58 larvae, Nov.-Dec. 1945, Ingram. TOL: Two males, reared from breadfruit tree hole, July 1952, Hu; one male, Mt. Unibot, Jan. 1953, Gressitt. WENA (Moen): One male, three females, reared from tin can, July 1952, Hu.

18. Aedes (Stegomyia) hakanssoni Knight and Hurlbut (fig. 7, *c, j*).

Aedes hakanssoni Knight and Hurlbut, 1949, Washington Acad. Sci., Jour. **39**: 23, figs. 3, 11, 13, 16 (type male, U. S. Nat. Mus.).—Marks, 1954, Bull. Brit. Mus. Ent. **3**: 352, pl. 18.

Female: Scutum with a thin, sometimes incomplete bowed line of whitish or yellowish-white scales along anterior margin, above *ppn,* inward from scutal angle and then posterior to lateral scutellar lobe; all scutellar lobes dark-scaled except for a few white basal scales sometimes on mid-lobe; pleural markings not so obviously linear as in most others of the subgroup; hind femur in front with a pale line tapering off ventrally short of knee spot; fore- and mid-tarsi with basal pale marks on I and II; hind tarsus with basal white bands, sometimes incomplete on I-III, that on I occupying about one-fourth of segment, those on II and III about one-third, IV-V with lateral patches only, that on IV occupying from two-fifths to three-fifths of segment, that on V extending up to middle. Abdominal tergites with laterobasal white spots continued onto sides of dorsum of II-VII as subbasal spots, scattered white scales present between spots, especially on V-VII.

Male: Lateral scutellar lobe white-scaled, mid-lobe with white basal and black apical scales. Genitalia as in figure 7, *c.*

Larva (data based on 10 specimens from Ponape) : Head hair 6 single or rarely double (5 percent). Comb of eight to 12 moderate, well-fringed scales (fig. 7, *j*) ; first and fifth pentads with three or four branches, third pentad with five to eight branches; siphon with nine to 16 pecten teeth in a straight row, each with a large subtooth and one or more denticles, followed by a hair with three to six branches; saddle bearing a lateral hair with three or rarely four slightly unequal branches; gills large, slightly unequal, pointed, 1.5-2.5 times as long as saddle; posterior hairs of anal fan double, *osc* double.

Pupa: The chaetotaxy as figured by Knight and Hurlbut (1949) is similar to that of most other species in the *scutellaris* subgroup.

Biology: Larvae have been collected in a banana stump, tree holes, glass bottles, coconut shells, steel rain barrels, and a canoe (Knight and Hurlbut, 1949, p. 26). The adults were not observed to bite.

DISTRIBUTION: Known only from Ponape, Caroline Is. The type locality is the associated small island of Sokas.

PONAPE. One male, two females, four pupal skins, 10 larvae, mostly paratypes, Palieij, Hydroplant, Matalanim, Sokehs (Sokas) Islet, Jan. 11-21, 1948, Hurlbut; one male, Kapingamarangi village, July 23, 1952, Hu.

19. **Aedes (Stegomyia) scutellaris** (Walker). (Figure 8, *f, m, t;* 9, *g;* 10, *h, i*).

Culex variegatus Doleschall, 1858, Nat. Tijds. Ned.-Ind. **17**: 77 (not *Culex variegatus* Schrank, 1781).

Culex scutellaris Walker, 1859, Linn. Soc. London, Proc. **3**: 77 (type ? female, British Mus.).

Culex zonatipes Walker, 1861, Linn. Soc. London, Proc. **5**: 229 (type ? female, British Mus.).

Aedes variegatus hebrideus Edwards, 1926, Bull. Ent. Res. **17**: 102 (type male, British Mus.).

Aedes hebrideus Edwards, of Farner and Bohart, 1945, U. S. Nav. Med. Bull. **44**: 46, figs. 13, 14.—Stone and Farner, 1945, Biol. Soc. Washington, Proc. **58**: 158.

Aedes zonatipes (Walker), of Bohart and Ingram, 1946, NAVMED **1055**: 26, fig. 20.

Aedes scutellaris (Walker), of Stone, 1947, Ent. Soc. Washington, Proc. **49**: 84.—Penn, 1947, Jour. Parasitology **33**: 43, figs. 1-7.—Knight and Hull, 1952, Pacific Science **6**: 180, figs. 12, 13.—Marks, 1954, Bull. Brit. Mus., Ent. **3**: 352, pl. 18.

Female: Hind femur in front with a white line tapering to a point near knee spot (fig. 8, *t*); fore- and mid-tarsi with broad white basal marks on I and II; hind tarsus with basal white bands on I-IV, V all white, band on IV covering at least the basal two-thirds (fig. 8, *f*). Abdominal tergites II and III usually with incomplete subbasal white bands, those on IV-VI usually complete or nearly so (fig. 8, *m*).

Male: Basal lobe of basistyle with a close-knit group of large setae as seen in dissected, flattened view (fig. 10, *h, i*).

Larva (data based only on eight specimens from Palau Islands): Comb of eight to 12 moderate scales with a fringe reaching only slightly below point of attachment (fig. 9, *g*); first pentad hair with two to four branches, third with three to six, fifth with two to four; siphon with five to 14 pecten teeth each with several basal subteeth, followed by a hair with two to five branches; saddle bearing a lateral hair with two unequal length branches; gills nearly equal, 2.5 to four times as long as saddle.

Pupa: The chaetotaxy has been figured by Penn (1947).

Biology: Larvae are found principally in artificial containers. Other habitats in descending order of frequency have been listed by Penn (1947) as coconut shells, tree holes, puddles, spathes and leaves, leaf axils and wells. Adults bite during the day in the shade but prefer to feed at dusk, at which time they readily enter buildings. On epidemiological evidence the species has generally been considered to be a vector of dengue fever in New Guinea and in the New Hebrides. It is possible also that it played this role in the Palau Islands where dengue epidemics have occurred (Sogen, 1941, Sei-I-Kai Med. Jour., Tokyo, **60**: 958-986). The biology on New Guinea has been given in detail by Penn (1947) and in review by Bick (1951, Pacific Science **5**: 392-431).

DISTRIBUTION: New Hebrides, Rennel and Bellona Is., New Guinea, Sumatra, Aru (type locality), Amboina, Moluccas, Celebes, Ceram, Andamans, Philippines, Palau Is., and west Caroline Is.

PALAU. KOROR: One male, Mar. 1948, Maehler. ANGAUR: Three males, two females, two larvae, Nov., Dec. 1944, Lewellen.

CAROLINE ATOLLS. PULO ANNA (southwest group): six larvae, in tree hole, Mar. 1945, Dorsey.

20. Aedes (Stegomyia) hensilli Farner (figs. 8, *e, l, q*; 9, *j*; 10, *f, g*).

Aedes hensilli Farner, 1945, Biol. Soc. Washington, Proc. **58**: 59 (type male, U. S. Nat. Mus.).—Stone and Farner, 1945, Biol. Soc. Washington, Proc. **58**: 156.—Bohart and Ingram, 1946, NAVMED **1055**: 25, fig. 21.—Marks, 1954, Bull. Brit. Mus., Ent. **3**: 352, pl. 18.

Female: Hind femur in front with a white line tapering to a point near knee spot (fig. 8, *q*). Fore- and mid-tarsi with basal white marks on I and II; hind tarsus with basal white bands on all segments (fig. 8, *e*), complete except on I, that on IV occupying from two-fifths to three-fifths of segment, V sometimes all white. Abdomen dorsally with sub-

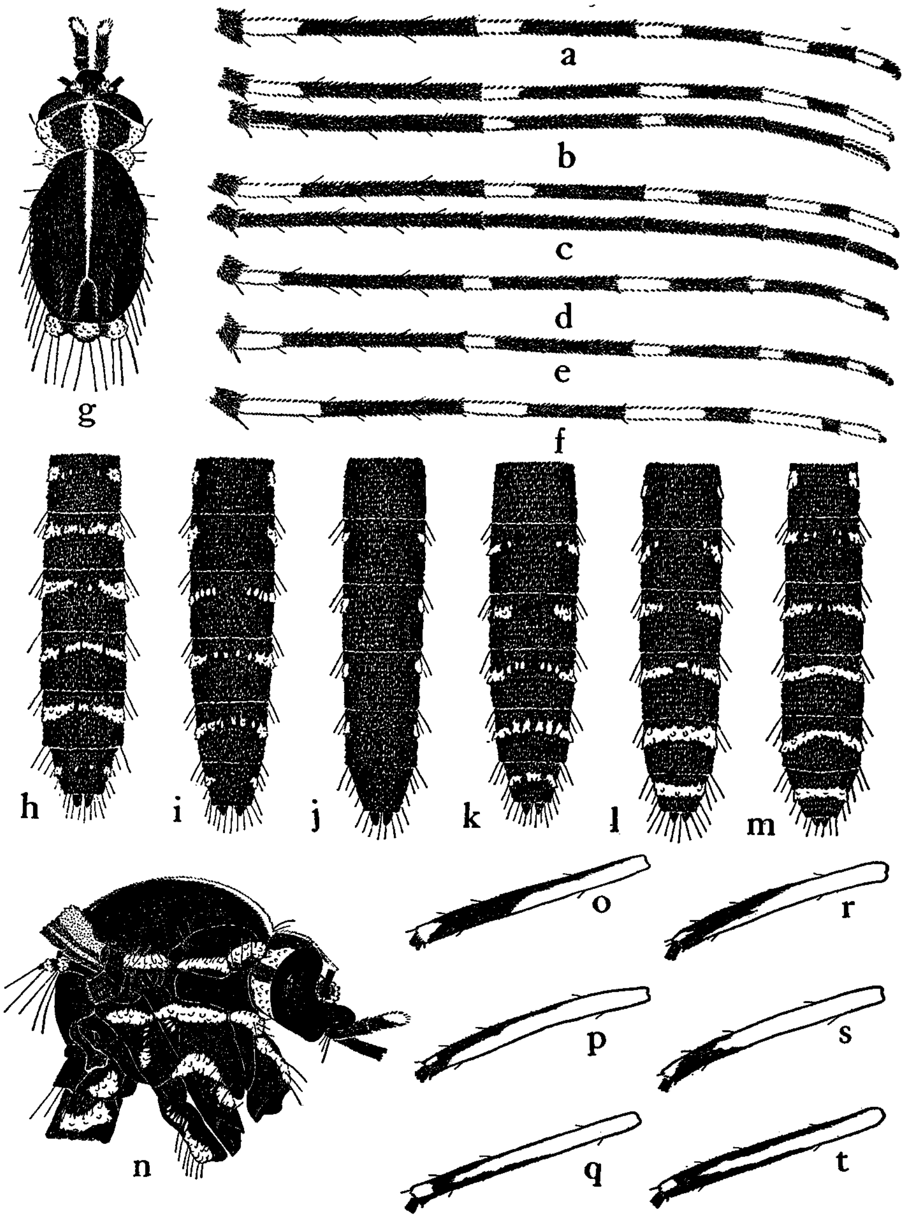

FIGURE 8.—*Aedes* (*Stegomyia*) *scutellaris* group. **a, g, h, n, o,** *dybasi: a,* hind tarsus, female, outer view; *g,* head and thorax, female, dorsal view; *h,* abdominal tergites II-VII, female, dorsal view; *n,* head, thorax, and base of abdomen, lateral view; *o,* hind femur, female, front view. **b, i, r,** *palauensis: b,* hind tarsus, female, inner view; *i,* abdominal tergites II-VII, female, dorsal view; *r,* hind femur, female, front view. **c, j, p,** *guamensis: c,* hind tarsus, female, inner view; *j,* abdominal tergites II-VII, female, dorsal view; *p,* hind femur, female, front view. **d, k, s,** *marshallensis: d,* hind tarsus, female, outer view; *k,* abdominal tergites II-VII, female, dorsal veiw; *s,* hind femur, female, front view. **e, l, q,** *hensilli: e,* hind tarsus, outer view; *l,* abdominal tergites II-VII, female, dorsal view; *q,* hind femur, female, front view. **f, m, t,** *scutellaris: f,* hind tarsus, outer view; *m,* abdominal tergites II-VII, female, dorsal view; *t,* hind femur, female, front view. (*a, b, g, h, i, n, o, r* after paratypes.)

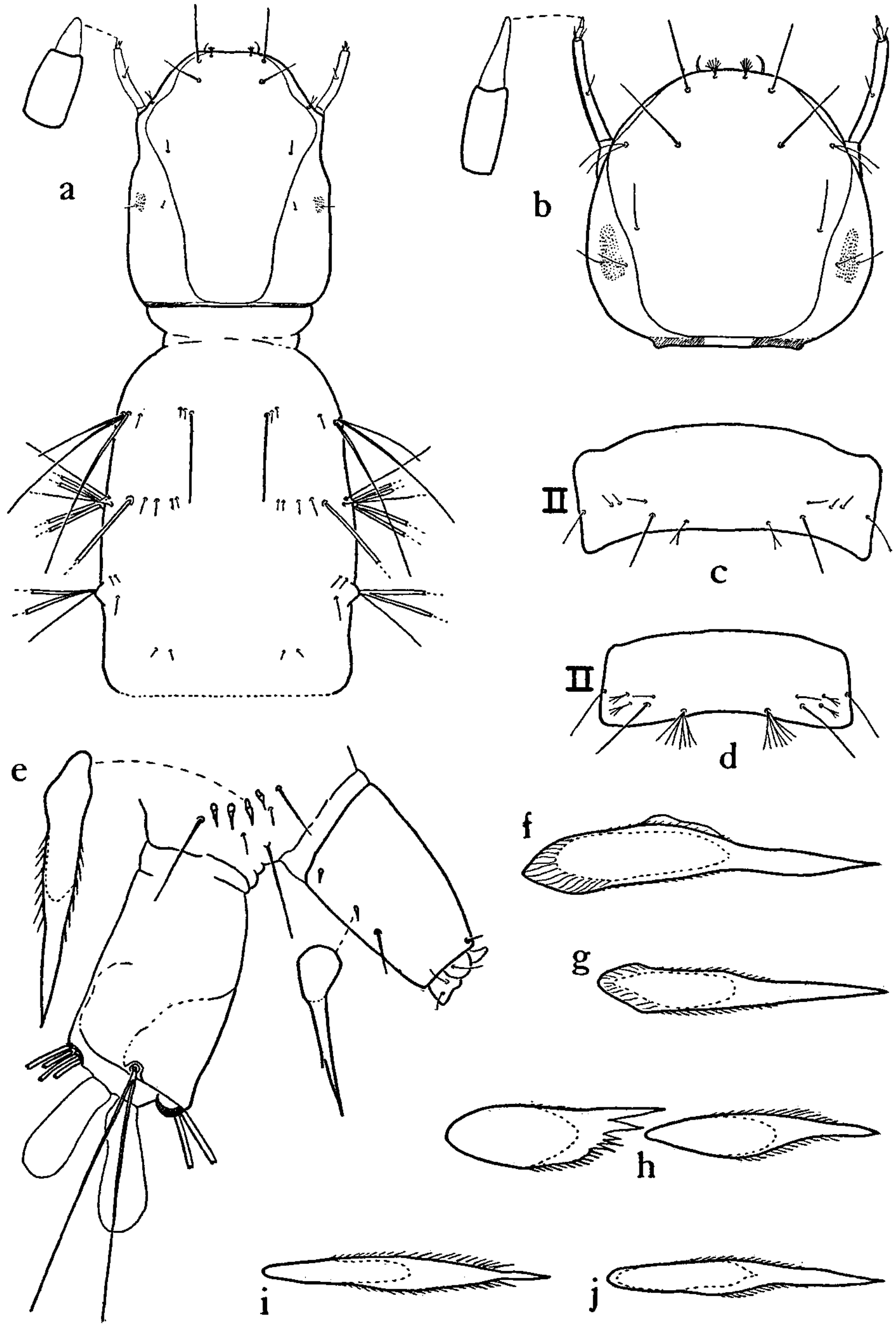

FIGURE 9.—*Aedes* (*Stegomyia*) *scutellaris* group, fourth stage larvae and pupae. **a**, **c**, **e**, *dybasi*: *a*, head and thorax, larva, dorsal view; *c*, tergite II, pupa; *e*, posterior segments, larva. **b**, **f**, *palauensis*: *b*, head, larva, dorsal view; *f*, comb teeth from middle of comb row, larva. **d**, **h**, *marshallensis*: *d*, tergite II, pupa; *h*, comb teeth from middle of comb row, larva. **g**, *scutellaris*; **i**, *guamensis*; **j**, *hensilli*: comb teeth from middle of comb row, larva. (*a-c*, *e*, *f* after paratypes.)

marks on I and II, hind tarsus with white bands which are interrupted on inner surface of I and IV, sometimes also on III and V (fig. 8, *b*), white area on I occupying about one-fourth of segment, about one-third of II, two-fifths of III, one-half of IV, and all of V. Abdominal tergites II-VII with large basal white spots continued onto dorsum as subbasal spots, sometimes forming broken bands, often complete on IV-VI (fig. 8, *i*).

Male: Length of wing 2.5 mm. Hind tarsus with bands incomplete on I, IV, and V. Abdominal dorsum with a median as well as lateral white spots on II, complete subbasal bands on III-VI and VIII, lateral spots on VII. Basal lobe of basistyle compact, short, with three large setae in a row at outer apex, an apical row of somewhat more slender setae, and a large number of bristles on the oblique, nearly rectangular posterior surface (fig. 10, *b*).

Larvae (data based on 38 specimens from Ngergoi and Peleliu Islands: Comb of six to 10 large scales (average 7.9) with a basal fringe only (fig. 9, *f*); first pentad hair with two to five branches (average 3.6), third with three to six (average 4.6), fifth with three to five (average 3.4); siphon with two to 10 well spaced pecten teeth (average 6.1, 88 percent with seven or fewer), followed somewhat beyond middle of tube by a hair with three to six branches (average 4.6); saddle bearing a lateral hair with two to five practically equal branches (average 3.7); gills nearly equal, dorsal pair about 1.5 times as long as saddle.

Holotype, male (US), Ngergoi (Garakayo) I., Palau Is., in coconut shell, Aug. 1945, C. K. Dorsey. Paratypes, six males, four females, one pupa, eight larvae, Garakayo I., in coconut shell, tree hole, *Pandanus* axil, Aug. 2-8, 1945, H. S. Dybas, C. Dorsey; 13 males, 15 females, 21 larvae, Peleliu, Palau Is., in tin can, Aug. 1-2, 1945, H. S. Dybas, C. Dorsey. Metatypes, one male and five females, Peleliu, Aug. 1945, C. Dorsey.

Biology: Larvae have been collected in tin cans, tree holes, and *Pandanus* axils. Nothing is known of the adult habits.

DISTRIBUTION: Known only from Ngergoi and Peleliu in the Palau Islands.

In common with *guamensis* and *dybasi* this member of the *scutellaris* superspecies has the white line on the anterior surface of the hind femur tapering off ventrally before the knee spot. Tarsal markings distinguish it readily from the other two species. *Palauensis* has the fewest pecten teeth, usually five or six, of any member of the subgroup except for *dybasi,* whose larva is unique. The rather wide spacing of the teeth is emphasized by the placement of the siphon hair beyond the middle of the siphon tube. The comb scales are the largest I have observed in the group. An idea of the relative size is given in figure 9, *e-j*. If *hensilli* should be a co-breeder on Ngergoi or Peleliu, the above characters in addition to the nearly equal-branched saddle hair of *palauensis* should be sufficient for separation.

23. **Aedes (Stegomyia) dybasi** Bohart, n. sp. (figs. 8, *a, g, h, n, o*; 9, *a, c, e*; 10, *a*).

"Korror sp.," Marks, 1954, Bull. Brit. Mus., Ent. 3: 382.

Agrees with subgroup characters and with the following specific ones:

Female: Length of wing 3.0 mm. Hind femur in front with a white line which tapers off ventrally short of knee spot (fig. 8, *o*); fore- and mid-tarsi with basal white marks on

Dedication: This species is named for H. S. Dybas, whose exceptionally fine collection has substantially increased our knowledge of Micronesian mosquitoes.

24. **Aedes (Stegomyia) guamensis** Farner and Bohart (figs. 8, *c, j, p*; 9, *i*; 10, *c*).

Stegomyia scutellaris (Walker), of Fullaway, 1912, Guam Agric. Exper. Sta. Rept. for 1911, 33.

Aedes pseudoscutellaris (Theobald), of Swezey, 1942, B. P. Bishop Mus., Bull. **172**: 199.

Aedes guamensis Farner and Bohart, 1944, Biol. Soc. Washington, Proc. **57**: 117, figs. 5, 6 (type male, U. S. Nat. Mus.).—Farner and Bohart, 1945, U. S. Nav. Med. Bull. **44**: 43, 49, figs. 10, 11.—Stone and Farner, 1945, Biol. Soc. Washington, Proc. **58**: 158.—Bohart and Ingram, 1946, NAVMED **1055**: 35, fig. 22.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 54, pls. 15, 16.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31**: 641.—Hull, 1952, U. S. Armed Forces Med. Jour. **3**: 1287.—Bailey and Bohart, 1952, Jour. Economic Ent. **45**: 947.—Marks, 1954, Bull. Brit. Mus., Ent. **3**: 352, figs. 17, 18, pl. 18.

Female: Hind femur in front with a white line which tapers off ventrally as it approaches knee spot (fig. 8, *p*). Fore- and mid-tarsi dark or with basal white marks, sometimes restricted to a few white scales; hind tarsus with basal white marks on outer side but all dark on inner side (fig. 8, *c*), white mark on IV about three-fourths as long as segment. Abdomen with laterobasal white spots on tergites, usually visible dorsally as small lateral subbasal spots on II-VII (fig. 8, *j*).

Male: Basal lobe of basistyle (fig. 10, *c*) similar to that of *hensilli.*

Larva (data based on 50 specimens from Guam and Saipan): Comb of eight to 15 moderate scales (average 11.5) with an extensive fringe reaching well below point of attachment (fig. 9, *i*); first pentad hair with one to six branches (average 3.6), third with three to seven branches (average 4.6), fifth with two to seven branches (average four); siphon with 10 to 20 small teeth (average 14), each with several subteeth, followed by a hair with three to eight branches (average five); saddle bearing a lateral hair with two to six (average 3.6) branches of nearly equal length; gills stout but pointed, longer pair twice the shorter and as long as or somewhat longer than saddle.

Biology: As in other species of the group, *guamensis* larvae are found in containers of various types, both natural and artificial. In 1945 it was the dominant tree hole mosquito and was never found closer than 50 feet to human habitation. In surveys made at this time females were not observed to bite man even near prolific breeding sources in jungle areas (Bohart and Ingram, 1946, p. 36). Yamaguti and La Casse (1950, p. 59) made similar observations —"In deep jungle the adults were numerous but did not bite humans. The adults were observed resting on vegetation very near the ground and upon being disturbed they very readily alighted on shoes and trouser legs where they were easily captured." However, Reeves and Rudnick (1951) reported

that 23 out of 7,809 mosquitoes collected from human bait were *guamensis*. Two of these were males. The remainder were presumably feeding or attempting to feed. Also contrary to previous findings, Reeves and Rudnick identified larvae and reared adults from artificial containers close to habitations.

DISTRIBUTION: Mariana Is. Widespread on Guam (type locality, Mata), also present on Rota, Saipan, and probably on Tinian (unpublished record of one female of *scutellaris* group collected by H. E. Cott in 1944).

S. MARIANA IS. SAIPAN: Two males, four females (two biting in woods in mornings); three pupal skins, six larvae, Mt. Magpi, in tree hole, Dec. 1944, and Sept. 1945, Hagen. ROTA: Twenty-one males, 20 females, two pupal skins, in tree holes, Oct. 1945, Bohart, Ingram. GUAM: Fifty-one males, 76 females, 33 larvae, 1948, W. C. Reeves; 12 males, 12 females, 31 larvae, Ritidian Point and Amantes Point, 1945, Dybas; one male, eight larvae, 1945, 1951, Bohart; one male, one female, 1911, Fullaway; one male, one female, Yona and Potts Junction, 1952, Krauss.

Group C (*scutellaris* group) subgroup II

25. Aedes (Stegomyia) albopictus (Skuse). (Figure 7, *d.*)

Culex albopictus Skuse, 1894, Indian Mus., Notes **3**: 20 (type female, Univ. Sydney, New South Wales).

Stegomyia scutellaris samarensis Ludlow, 1903, New York Ent. Soc., Jour. **11**: 138 (cotypes, two males, four females, U. S. Nat. Mus.).

Stegomyia lamberti Ventrillon, 1904, Paris Mus. Bull. **10**: 552.

Stegomyia nigritia Ludlow, 1910, Canadian Ent. **13**: 194 (two female cotypes, U. S. Nat. Mus.).

Stegomyia quasinigritia Ludlow, 1911, Psyche **18**: 129 (type male, U. S. Nat. Mus.).

Aedes albopictus (Skuse), of Dyar and Shannon, 1925, Ins. Inscit. Mens. **13**: 74.—Edwards, 1932, Genera Insectorum, Dipt. **194**: 164.—Bohart and Ingram, 1946, NAVMED **1055**: 5, 35, 64, fig. 17.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 48, plates 13, 14.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31**: 648.—Knight and Hull, 1952, Pacific Science **6**: 176, fig. 10.—Hull, 1952, U. S. Armed Forces Med. Jour. **3**: 1287.

Female: Similar to species in *scutellaris* subgroup but differing principally as follows: Pleural scale patches arranged in spots rather than in lines; fore- and mid-tarsi with basal white marks on I-II or I-III; hind femur with white area tapering to a point short of knee spot; hind tarsal IV about three-fifths white, V all white. Abdominal tergites with narrow and often incomplete basal bands which widen into spots near dorsal margin, detached lateral (ventral) spots also present.

Male: Ninth tergite with a backward projecting median knob (fig. 7, *d*); basal lobe of basistyle with setae of varying lengths but of similar nature.

Larva (data based on 25 specimens from Saipan): Apparently inseparable by constant characteristics from *hensilli* or *scutellaris.* First pentad hair with three to six branches (usually three), third with three to eight branches (usually five), fifth with two to five branches (usually three); comb of seven to 11 basally fringed scales; pecten with seven to 14 teeth (average 11); siphon hair with two to four branches (usually three); lateral hair of saddle with two or sometimes three unequal branches.

Biology: Larvae are most often found in artificial containers and tree holes, but sometimes in rock holes and leaf axils. The species tends to be semidomestic and larvae are usually most numerous near habitations or places frequented by human beings. The adults are severe pests in wooded areas where they rest under leaves and bite during the day. The species is generally considered to be an important vector of dengue.

DISTRIBUTION: Oriental Region generally (type locality, Calcutta, India); Hawaii; Mariana Islands of Guam, Tinian, Saipan, and Pagan; Bonin Islands. It has not previously been known from Pagan Island or the Bonins. Its earliest recorded appearance on Guam seems to be March 1, 1948. Yamaguti and La Casse (1950) reported three collections from Yona of that date, and Reeves and Rudnick (1951) reported 113 collections spread over most of the northern two-thirds of the island from March 1, 1948 through January 1949.

BONIN IS. CHICHI JIMA: Five males, 11 females, in artificial containers, July 1951, Bohart; one female, Omura, July 1949, Mead. HAHA JIMA: One female, biting, July 1951, Bohart.

N. MARIANA IS. PAGAN: Nine males, eight females, many larvae, in coconut tree hole and water drum, July 1951, Bohart.

S. MARIANA IS. SAIPAN: Many larvae and adults, 1945, H. S. Dybas; 1951, Bohart; 1952, S. M. K. Hu. TINIAN: Three larvae, Tinian Town and Mt. Lasso, in artificial containers, Aug., Sept. 1944, Bailey, Cott; one male, two females, Mar. 1945, Dybas. GUAM: Many larvae and adults, Yona, Vennel Bosey, Toto, Pago Valley, Asan, Ordot, Sinajana, Marbo, and North Field, 1948, W. C. Reeves; six larvae, Merizo, in coconut shell, Sept. 1951, Bohart; three females, Tutujan, Nov. 1952, Gressitt; three pairs, Mt. Santa Rosa, in coconut shell, Aug. 1952, Hu.

Knight and Hull (1942) place *albopictus* in subgroup II, *albopictus* of group C (*scutellaris* group). This subgroup has basal pale markings on the abdominal tergites, no postspiracular scales, a spotted rather than a linear pleural pattern, and a slender median scutal line. The last two of these characters are sufficient to distinguish it from all other species in Micronesia and the Bonins. However, the larva and pupa are practically inseparable from those of *hensilli* and *scutellaris.* At present this does not create a field problem in identification because *albopictus* is not known from the Carolines, where the other two occur.

Subgenus **Aedimorphus** Theobald

26. Aedes (Aedimorphus) vexans nocturnus (Theobald). (Figure 11, *c, d.*)

Culex nocturnus Theobald, 1903, Monograph Culicidae **3**: 159, figs. 86, 87 (type female, British Mus.).

Culex nocturnus niger Theobald, 1913, Nova Caledonia, Zool. **1**: 164 (type, sex unknown, Basle Museum.

Aedes vexans Meigen, of authors dealing with Australasian fauna.

Aedes vexans nocturnus Bohart and Ingram, 1946, NAVMED **1055**: 15, 22, 41, fig. 69.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 73, plates 21, 22.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31**: 641.—Knight and Hull, 1953, Pacific Science **7**: 460, fig. 6.

Female: Length of wing about 3.5 mm. Proboscis rather pale beneath medially; palpus white-tipped; torus pale-scaled mesally; vertex with some dark and pale upright scales, many yellowish curved scales in median area. Scutum with an indefinite pattern of bronzy brown, yellow, and whitish scales; pleuron with three large and a few small patches of grayish-white scales; wing dark or with a few pale scales toward leading edge; all femora speckled, knee spots present; hind tarsus with narrow basal pale bands on all segments. Abdominal tergites with basal creamy bands and lateroventral spots, some of the bands more or less incised at middle, V and following sometimes with apical pale scales.

Male: Palpus densely hairy toward apex, longer than proboscis by about one-half of last segment. Genitalia with bladelike dististyle (fig. 11, *d*).

Larva: Antenna spiculate, a branched hair before middle, clypeal spine slender, head hair 6 single, hair 5 single to triple, hair 4 minute and with three to five branches; mentum with 27 to 31 teeth. Pronotal hair 1 single, 3 single or double. Comb of eight to 11 strong and sharp teeth in a partially double row (fig. 11, *c*); first and second pentad hairs on a plate, first, third, and fifth with five or more branches; siphon with an acus, 11 to 18 teeth in pecten row, with distal one to three more widely spaced, an inconspicuous tuft beyond middle with three to five branches; saddle nearly complete, lateral hair small and single; anal fan of about 16 brushes of which basal few are outside barred area; gills moderate, about equal; *isc* with about eight branches, *osc* single.

Biology: When ground pools are filled by excessive rains, this species becomes common and the adult females frequently seek human blood at night and by day. Because its annual December population peak on Guam coincided with the epidemic of Japanese B encephalitis of 1947, because it has transmitted this virus in the laboratory (Hodes, 1946, Bull. Johns Hopkins Hospital **79**: 358-360), and because it has a broad host range, it is under suspicion as a disease vector. The most pertinent and extensive information on larval habits was given by Reeves and Rudnick (1951). Of their 96 records, 81 were ground pools, seven were rain barrels, five were household containers, two were tire casings, and one was a coconut shell.

DISTRIBUTION: Widespread from Australia (type locality, Fiji) to Indonesia and the Philippines. Micronesian island groups include the Marshalls (Ebon Atoll), Carolines, and Marianas.

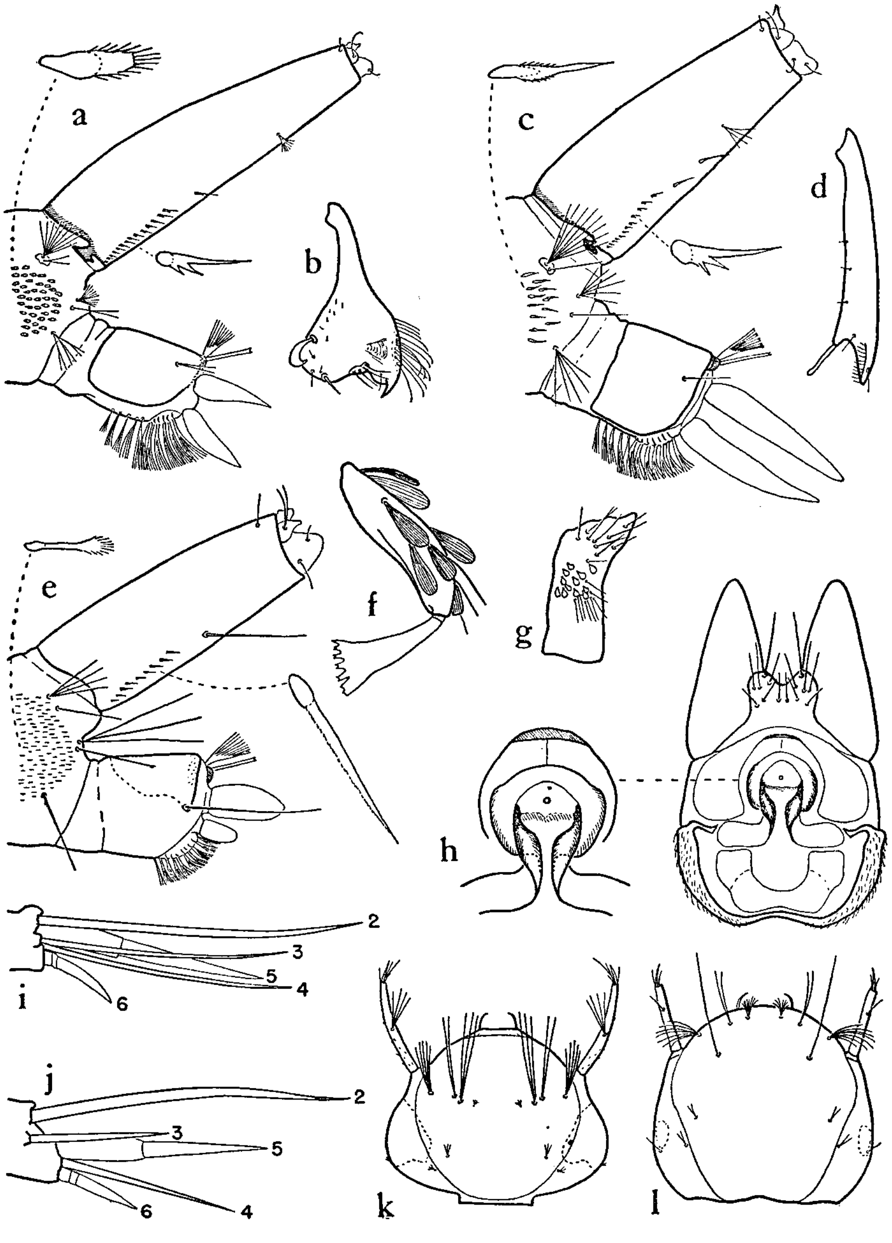

FIGURE 11.—*Aedes* (*Aedimorphus*). **a, b, j, k,** *oakleyi: a,* posterior segments, larva; *b,* dististyle; *j,* tip of right antenna, larva, dorsal view; *k,* head, larva, dorsal view. **c, d,** *vexans nocturnus: c,* posterior segments, larva; *d,* dististyle. **i,** *senyavinensis,* tip of right antenna, larva, dorsal view. *Aedes* (*Skusea*)*:* **e, f, l,** *lamelliferus: e,* posterior segments, larva; *f,* dististyle; *l,* head, larva, dorsal view. *Aedes* (*Aedes*)*:* **g, h,** *pipkini: g,* mesepimeron, female; *h,* genitalia, female, genital area enlarged at left. (*f, i* after paratypes.)

S. MARIANA IS. SAIPAN: Four males, 19 females, one larva, As Mahetog, Laulau Bay, Nov.-Dec. 1944, Dybas; 12 males, 16 females, near Chalan Kanoa, June 1951, Bohart. TINIAN: Seventeen females, Marpo Valley, day biting, Mar. 1945, Dybas. GUAM: Sixty-two males, 64 females, 80 larvae, Inarajan, Merizo, Almagoso Springs, Chalan Pago, Ordot, Yigo, Talofofo, Ylig Valley, Mar., Oct., Nov., Dec. 1948, W. C. Reeves; one female, 1911, Fullaway; five males, nine females, six larvae, Port Ajayan, June 1945, Dybas; three larvae, Point Oca, Sept. 1945, Bohart.

PALAU. BABELTHUAP: Two females, Ulimang, around buildings, Dec. 1947, Dybas.

YAP. YAP: Twenty-five females, Yap and Map I., July-Aug. 1950, Goss; four larvae, Oct. 1954, Gardella.

CAROLINE ATOLLS. IFALUK: Three males, 10 females, Ifaluk I., Aug. 1953, Bates.

MARSHALL IS. EBON.

This species belongs to Edwards' group G (*vexans* group) in which the scutellar scales are narrow and the tarsi are white-banded. The bladelike male dististyle (fig. 10, *d*), which is usually visible without dissection, is diagnostic for Micronesia. The pupal chaetotaxy has been described and figured by several authors, notably Penn (1949, Pacific Science **3**: 3-85). The finely serrate apical paddle margin is a distinguishing feature.

27. **Aedes (Aedimorphus) oakleyi** Stone (fig. 11, *a, b, j, k*).

Aedes oakleyi Stone, 1939, Ent. Soc. Washington, Proc. **41**: 163, fig. 113, (type female, U. S. Nat. Mus.).—Bohart and Ingram, 1946, NAVMED **1055**: 41, figs. 33, 68.—Knight and Hurlbut, 1949, Washington Acad. Sci., Jour. **39**: 28.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 67, pls. 19, 20.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31**: 642.—Hull, 1952, U. S. Armed Forces Med. Jour. **3**: 1294.

Female: Vertex with pale narrow scales and abundant dark upright scales in median area; palpus short and dark-scaled; proboscis with dull yellow scales along most of basal two-thirds except dorsally. Scutum with mixed reddish brown and pale scales; scutellum with shining yellowish-white broad scales and a few narrow ones laterally; *apn* with pale broad scales, *ppn* with pale and dark narrow scales; pleuron pale brown with several small patches of pale scales; wing scales dark; tarsi brown without pale bands. Abdomen dark brown with yellowish-white basal tergal bands, wider and paler laterally; venter all pale.

Male: Palpus longer than proboscis by nearly length of distal segment; last two segments with long hairs. Abdominal tergite VIII all pale-scaled; dististyle as in figure 11, *b*.

Larva (data based on 15 specimens from Guam, Saipan, and Anatahan): Head as in figure 11, *j* and *k*; apical antennal setae 3 and 4 unequal; head hair 6 double or triple (63 percent double), hair 5 double to quadruple (70 percent triple), mentum with 36 to 39 teeth. Pronotal hairs small as in figure *l, h*. Comb of 27 to 50 broad, apically fringed scales in a patch (fig. 11, *a*); first and third pentad hairs many-branched tufts, second and fourth usually double or split, fifth pentad with five to seven branches, siphon

about 3.5 to 4.5 times its basal diameter, with 16 to 21 pecten teeth of which most distal is more widely spaced; followed at apical one-third of tube by a fine hair tuft; saddled with a fine single to quadruple lateral hair; gills about as long as saddle, pointed; *osc* single, *isc* with about seven branches.

Biology: The type series was reared from larvae in a water drum (Stone, 1939). They have since been found in a variety of containers but are rare except during the fall-winter rainy season. The most extensive findings were those of Reeves and Rudnick (1951) who reported 35 collections of larvae on Guam from household containers, barrels, tree holes, tire casings, coconut shells, a car fender, and a scrap metal dump. A few records are from ground pools. The females are not known to take human blood. In fact, the presence of numerous larvae in holes of large trees as I found them in the interior of the uninhabited island of Anatahan indicates their ability to get blood from one or more of the few local animals such as birds or lizards.

DISTRIBUTION: The Mariana Islands of Guam (type locality, Root Farm), Saipan and Anatahan. The last two localities are new island records. Guam localities in addition to those below are Barrigada, Yona, Yigo, Ritidian Point (Bohart and Ingram, 1946); and Agana, Asan, Mongmong, Santa Rita, and Inarajan (Reeves and Rudnick, 1951).

N. MARIANA IS. ANATAHAN: Twenty males, 13 females, 15 larvae, 14 pupal skins, in breadfruit tree holes, July 1951, Bohart.

S. MARIANA IS. SAIPAN: Four males, seven females, 14 larvae, in slit trench, Sept. 1945, Dybas. GUAM: Fifteen males, 28 females, 79 larvae, Talofofo, "Com. Mar.," Dealy Beach, Agana, Piti, Tarague, Marine Drive, Nov.-Dec. 1948, Rudnick, Durocher, Hall; four larvae, one pupal skin, Ritidian Point and Yigo, in tree hole and tin can, May 1945, Dybas; two females, Port Ajayan, road rut, June 1945, Dybas.

Group C (*alboscutellatus* group), as redefined by Knight and Hurlbut (1949), contains those *Aedimorphus* in which the male palpi are as long as the proboscis, the last two segments noticeably hairy, the last segment not very short; and the basistyle with the basal lobe small or absent. Ten species are known, with three occurring in Micronesia. The shining, creamy, broad scutellar scales of *oakleyi* are distinctive. In the pupa the unusually small hair C-II and the minute, plumose paddle hair are characteristic. The respiratory trumpet and paddle hair have been illustrated by Bohart and Ingram (1946).

28. Aedes (Aedimorphus) senyavinensis Knight and Hurlbut (fig. 11, *i*).

Aedes senyavinensis Knight and Hurlbut, 1949, Washington Acad. Sci., Jour. **39**: 27, figs. 4, 15, 17, 19 (type male, U. S. Nat. Mus.).

Differs from *oakleyi* essentially as follows:

Female: Each scutellar lobe with a patch of narrow black scales and some narrow yellow scales basally; *apn* with a few narrow scales. Abdominal tergites without complete pale bands except sometimes indistinctly on IV and V.

Male: Dististyle differing from that of *oakleyi* as indicated in the key.

Larva: Apical antennal setae 3 and 4 about equal in length (fig. 11, *i*); head hair 6 triple, mentum with 29 to 35 teeth. Gills somewhat longer than saddle.

Pupa: The paddle has been illustrated by Knight and Hurlbut (1949). The pupa differs from that of *oakleyi* as indicated in the key.

Biology: Larvae are reported by Knight and Hurlbut (1949) as numerous in clear water in axils of young palms. Larvae were also found in rainwater in a steel barrel. Adults were not observed except for one female taken in a trap baited with a live pig.

DISTRIBUTION: Known only from Ponape in the Caroline Islands (type locality, Rekisau, Ponape).

PONAPE: One male, two females, two larvae, three larval skins, three pupal skins, Rekisau, Net District, in young palm axils, Jan. 20, 1948, Hurlbut; one female, Mechikku, in pig trap, Feb. 1948, Hurlbut; two females, Lehdau, July 22, 1939, Esaki.

The male genitalia indicate that *senyavinensis* is very close to *oakleyi* in group C (*alboscutellatus* group). However, the nature of the scutellar scales and other characters given in the keys are ample for separation.

29. Aedes (Aedimorphus) trukensis Bohart, n. sp.

Female: Length of wing 3.5 mm. Proboscis with a dull pale line beneath, broadened for a short distance beyond middle; palpus dark, about one-eighth as long as proboscis; torus bare, pale brownish; median area of vertex with hairlike yellowish curved scales and many upright dark ones, median area bordered by some broad dark scales and then a large patch of pale broad ones. Scutum covered with minute, dark reddish-brown scales; a few small yellowish scales anteriorly, at scutal angle and over wing base; a well-defined spot of small golden scales sublaterally at middle of scutal length; scutal bristles dark; *apn* with a few dull pale broad scales; *ppn* with some small, dark, curved scales. Pleuron dark brown with patches of pale scales on propleuron, sternopleuron (two), and upper mesepimeron; scutellum with narrow curved dull golden scales on lateral lobe, dark broad scales with a bronzy luster on mid-lobe. Wing and halter knob scales dark; femora pale beneath, tibiae with an anterior apical patch of white scales; tarsi dark. Abdomen above dark-scaled with a suggestion of paler scales basally on III and IV, and with a basal lateral whitish spot on VII; similar spots on tergites I-VI ventrally, continuous with more yellowish basal bands on sternites.

Holotype, female (KU), "Pata-Sabote-Epin," Ton, Truk, Apr. 10, 1940, K. Yasumatsu, S. Yoshimura; paratype, one female, same data as holotype.

DISTRIBUTION: Eastern Caroline Is. (Truk).

From its similarity in markings to *alboscutellatus* (Theobald) it seems likely that this species belongs in group C. Until the male is known, however, no positive placement can be made. It differs from *alboscutellatus* in having a pair of distinct golden spots half way back on the scutum, in the narrowed yellowish scales laterally on the scutellum, the bronzy broad scales of the mid-scutellar lobe, and the dark femoral apices. In *alboscutellatus* there are usually, but not always, narrow basal pale bands on the tergites. These may be variable in *trukensis,* also, as the paratype has a few definitely pale scales basally on IV-VI.

Subgenus **Skusea** Theobald

30. Aedes (Skusea) lamelliferus Bohart and Ingram (fig. 11, *e, f, l*).

Aedes lamelliferus Bohart and Ingram, 1946, NAVMED **1055**: 29, figs. 28, 62 (type male, U. S. Nat. Mus.).

Female: Vertex with broad dark scales and a few pale ones on nape and laterally; dark upright scales on nape and a row pointing forward over eyes toward middle; mouthparts dark. Scutum with bronzy black scales on dark integument, a few paler ones in front; *apn* with pale broad scales, *ppn* with dark broad ones; scutellum with dark broad scales on all lobes; pleuron with large patches of dull pale scales; wing scales dark; legs dark except toward base of femora behind and hind femur in front. Abdomen dark above, tergites with laterobasal (ventral) white spots.

Male: Palpus three-fourths to four-fifths as long as proboscis. Genitalia with a series of clublike setae borne on a basal lobe, a group of curved hairs at apex of basistyle; dististyle with a fanlike tooth (fig. 11, *f*).

Larva: Head as in figure 11, *l;* head hair 6 single or double; mentum with about 23 teeth. Pronotal hair 1 with three or four branches, 2 single, 3 single to quadruple. Comb with nearly 100 slender scales (fig. 11, *e*); first and third pentad hairs with two to five branches, fifth single or double; siphon about 2.7 times its basal diameter, pecten of seven to 12 slender, finely fringed teeth; siphon hair long, single, inserted medially on tube; about one-third of anal segment covered by saddle, lateral hair long and single; gills unequal and varying from shorter than saddle to twice its length; *osc* single, *isc* many-branched.

Pupa: Similar to those of the *scutellaris* subgroup but differing in the more branched hair A-VIII, the very short hair C-II, and the more extensive paddle fringe. The paddle and breathing trumpet have been illustrated by Bohart and Ingram (1946).

Biology: Larvae occur in mangrove swamps on Truk where they are found in both fresh and highly brackish water of palm axils and tree holes. Females have been taken biting in or near swamps from midday to early evening. However, Bohart and Ingram (1946) state that "In view of the abundance of larvae in swamps (nearly every palm axil contained numerous larvae) and the fact that few adults attempted to bite, it appears that either man is not the preferred host or that the desired feeding time is not during the day."

DISTRIBUTION: Truk (type locality, Moen Island), Ponape, Peleliu, Babelthuap.

PALAU. BABELTHUAP: Three females, Ulimang, near building, Dec. 1947, Dybas. PELELIU: Four females, Aug. 1945, Dorsey; one pair, 12 larvae, in ammunition tin, July 1945, Dybas.

TRUK. WENA (Moen): Seven males, five females, 18 larvae, three pupal skins, in nipa palm axil, Dec. 1945, Ingram; two females, in container near house, July 1952, Hu.

PONAPE: Two females, Japtik, Jan. 1938, Esaki.

The three other species of this subgenus from the Oriental Region and New Guinea are *amesii* (Ludlow), *fumidus* Edwards, and *dasyorrhus* King and Hoogstraal. The four species are very similar in most respects of adults and larvae. However, there are several differences in male genitalia. The peculiar fan-shaped dististyle tooth is diagnostic for *lamelliferus.*

Subgenus **Aedes** Meigen

31. Aedes (Aedes) pipkini Bohart, n. sp. (fig. 11, *g, h*).

Female: Length of wing 2.5 mm. Mouthparts dark, palpus very short; median area of vertex with a few posterior pale broad scales in the mid-line and about 12 upright black scales on nape, otherwise covered with dark, broad scales, a white spot sublaterally on head. Thoracic integument dark brown, scutal and scutellar scales brown to black, narrow curved; scales of wing and halter knob dark; anterior median part of sternopleuron without hairs, scales of upper sternopleural patch extending a little over half way to anterior angle of sclerite, about 10 brownish upper mesepimeral bristles and a similar number of shorter pale ones associated with posteroventral corner of scale patch (fig. 11, *g*); meteusternum bare; femora above, tibiae and tarsi dark, hind tarsal claws equal and simple. Abdomen with basolateral ventral spots continued onto dorsum as subbasal spots on II and VI and as oblique broken bands on III-V. Genitalia (fig. 11, *h*) with postgenital plate deeply emarginate; postatrial sclerite convex medially; postatrial plate darkly pigmented posteriorly, without hair; preatrial plate U-shaped, not sclerotized, without hair; preatrial sclerite emarginate anteriorly.

Biology: Larval habits are unknown. The adults are vicious biters of man. According to Pipkin (1953, unpublished address, Eighth Pacific Sci. Congr., Manila) this species is unable to withstand infection with the Micronesian strain of the filariasis organism, *Wuchereria bancrofti*. Furthermore, its day-biting habits would tend to rule it out as a carrier of filariasis in the Carolines.

Holotype, female (US), Wena (Moen), Truk Is., biting, July 1952, S. M. K. Hu; paratypes, 17 females, same data as holotype; 12 females, Ton, Truk Is., biting, July 1952, S. M. K. Hu.

PALAU. Peleliu: One female, Aug. 1939, Esaki.

YAP. Yap, Map, Gagil-Tomil Districts: Thirty-three females, July-Aug. 1950, Goss. Ruul District: One female, Sept. 1939, Esaki.

CAROLINE ATOLLS. Merir: Thirty-three females, vicious biters, Sept. 1952, Krauss. Pulo Anna: Fourteen females, Sept. 1952, Krauss.

DISTRIBUTION: Western and eastern Caroline Is. (Palau, Yap, Truk).

Although members of this subgenus are satisfactorily characterized only in the male, the female of this species seems to be sufficiently different to make it worthwhile naming. In the key of Barraud (1934, Fauna of India, Dipt. **5**) the more extensively pale-marked specimens of *pipkini* run to *indicus* Barraud. The type of mesepimeral bristles and female genitalia are entirely different, however. In the key of Knight and Hull (1951, Washington Acad. Sci., Jour. **39**) to the Philippine species, and that of King and Hoogstraal (1947, Washington Acad. Sci., Jour. **37**) to the New Guinea species, it runs closest to *panayensis* Ludlow but the sternopleural scale patch does not reach the anterior median angle of the sternopleuron. Also, according to paratypes of *panayensis* and specimens of it from New Guinea furnished for comparison by Alan Stone, the bristles of the mesepimeron are more numerous and the lower ones are not so closely associated with the scale patch as in *pipkini* (fig. 11, *g*). In the female genitalia *panayensis* has the preatrial plate covered with hair, whereas

having a transverse row of stiff bristles on the male proboscis beneath; the male palpus surpassing the proboscis, with a basal fingerlike projection, and weakly haired; and the male basistyle without an inner row of bristles. It differs from *hilli* in having yellow or pale-brown upright vertex scales instead of nearly black ones. Also, *hilli* has a few strong bristles on the subterminal male palpal segment. The larva of *carolinensis* has an unusually short siphon and long siphon tufts. The larva of *hilli* has not been described, but that of *hilli buxtoni* Edwards is very different, with a long siphon, apically as well as basally darkened antenna, and two- to three-branched head hairs 6 and 5. The pupa of *carolinensis* is distinguished by the unusually long and strong apical paddle bristle. The paddle and respiratory trumpet have been figured by Bohart and Ingram (1946). The single hair K-I and many-branched C-II may be a characteristic which the species in this group of the subgenus have in common.

33. Culex (Lophoceraomyia) gossi Bohart, n. sp. (fig. 12, *d-f*).

Female: Length of wing 2.8 mm. Median area of vertex with dark narrow and upright scales; mouthparts dark, palpus about one-sixth as long as proboscis. Scutum, scutellum, and wing dark-scaled, thoracic integument medium brown becoming straw-colored laterally; pleuron without markings, one lower mesepimeral bristle, a few inconspicuous scales on upper sternopleuron; bristles of mid-coxa brownish; legs dark except femora toward base. Abdominal tergites II-VI dark except for indistinct, dull, pale laterobasal spots.

Male: Torus without a knob; flagellum as in figure 12, *d*, segment VI with four long dark setae and six long pale ones; other specialized setae on VII to XI (counting torus as I), those on VII not always appearing divided in some paratypes; proboscis with a transverse basoventral row of stiff bristles; palpus with a short projection beneath at base; palpus exceeding proboscis by length of last segment, sparsely haired. Genitalia as in figure 12, *e, f;* basistyle with a row of four long, apically curved setae along inner ventral surface.

Larva: Antenna heavily spiculate before tuft at apical two-sevenths, constricted beyond, subapical bristles inserted well before apex but surpassing them, color of shaft brown with a black basal ring and darkened beyond tuft. Clypeal spine dark, moderately straight and slender; head hair 7 with six branches, hairs 5 and 6 with two, hair 4 single and placed well in front of hair 6; mentum with about 21 teeth. Pronotal hairs 1 and 2 as strong as 4 and 5. First pentad hair with four or five branches, third with eight, fifth with two or three; siphon about 6.5 times its basal diameter, with about 14 pecten teeth, followed on distal three-fifths of tube by four somewhat irregularly spaced triple or quadruple hairs, the longest about one-seventh as long as siphon; saddle posteriorly with short spicules, lateral hair double or triple; gills as long as saddle; 12 anal hair brushes, all in barred area; *osc* single; *isc* with about four branches, one of them long.

Holotype, male (US), Kolonia, Yap I., July-Aug. 1950, R. J. Goss. Paratypes, two females, same data as holotype; 10 males, two females, Mt. Madaade, Yap I., Dec. 2, 1952, J. L. Gressitt.

YAP. YAP: Two females, Oct. 1952, Krauss. RUMUNG: Two larvae, Nov. 11, 1946, D. G. Frey.

DISTRIBUTION: Western Caroline Is. (Yap).

This species is similar to *fraudatrix* Theobald and belongs in Edwards'

group B (*fraudatrix* group). However, the specialized bristles on antennal segment VI of *gossi* are not broadened scale-like (fig. 12, *d*), there is a broad paddle on the subapical lobe of the basistyle (fig. 12, *f*), and four long setae in a row below the subapical lobe. The mesosome plates differ in having a special form apically rather than tapering evenly to a point (fig. 12, *e*). The larva agrees with that of *fraudatrix* in most respects but the siphon is considerably shorter, and there is no median dark ring.

Dedication: This species is named for the collector, R. J. Goss.

34. Culex (Lophoceraomyia) kusaiensis Bohart, n. sp. (fig. 12, *g, k*).

Female: Length of wing 3.0 mm. Median area of vertex with dark narrow and upright scales; mouthparts dark, palpus about one-sixth as long as proboscis. Scutum, scutellum, and wing dark-scaled, thoracic integument dark brown above to medium brown on pleuron, which has a somewhat darker zone extending posteriorly from propleuron; one lower mesepimeral bristle; a few inconspicuous scales on upper sternopleuron; bristles of mid-coxa black; legs dark except femora toward base. Abdominal tergites dark-scaled, with purplish reflections.

Male: Torus without a knob; antenna as in figure 12, *f*, segments VII to X with modified tufts, XI with some thickened hairs; proboscis with a transverse basoventral row of stiff bristles; palpus with a short projection beneath at base; palpus slightly shorter than proboscis, last two segments with numerous short hairs. Genitalia as in figure 12, *h, i*; basistyle with numerous bristles laterally and extending ventrally but without a discrete inner ventral row; two most basal rods of subapical lobe of basistyle ending in membranous flaps; mesosome plate long, slender, and curved before apical point.

Larva: Antenna heavily spiculate before tuft at apical two-sevenths, constricted beyond, subapical bristles inserted near apical ones but not surpassing them, shaft darkened at base and slightly so beyond tuft; clypeal spine medium brown and somewhat curved; head hair 7 with six to eight branches, hair 6 with three or four, hair 5 with four or five, hair 4 single at base but divided near middle into three to five branches, placed slightly in front of hair 6; mentum with about 23 teeth (fig. 12, *k*). Pronotal hairs 1 and 2 much weaker than 4 and 5. Comb in a patch, first pentad hair double or triple, second often double, third with five or six branches, fifth minute and triple or quadruple; siphon about six times its basal diameter, with three to nine usually curved pecten teeth on basal one-third of tube, usually not more than five teeth well developed, followed by four irregularly placed tufts (sometimes three or five) with two to four branches, longest about one-ninth as long as siphon (fig. 12, *j*); saddle posteriorly with minute spiculation only, lateral hair usually triple; gills about as long as saddle; 12 anal hair brushes, all in barred area; *osc* single; *isc* double or triple.

Pupa: Respiratory trumpet about 11 times as long as its median diameter. Hair K-I single, C-II many-branched and about one-half as long as B-II, A-VIII with four to six main branches. Longer paddle hair curved and about one-tenth as long as paddle rib.

Holotype, male (US), Weye Cave, Kusaie I., light trap, Mar. 10, 1953, J. F. G. Clarke. Paratypes, three males, seven females, same data as holotype; one male, Pukusrik, light trap, Feb. 13, 1953; one male, Kusaie, Hill 1010, at light, Apr. 13, 1953; three females, Mt. Matante, light trap, Apr. 23, 1953; one female, Matanluk, Feb. 15, 1953; one female, Mt. Wakapp, at light, Apr. 27, 1953, Clarke. Topotypes, 54 larvae and four pupae, Kusaie, ground pool, Mar. 7, 1953, Clarke.

Biology: According to Clarke's original collecting notes, larvae and pupae were "collected in water accumulated on the floor of Weye Cave to a depth of several feet. These were taken near the mouth of the cave where they occurred in thousands. The water was covered with insect remains and debris from the nests of the thousands of swiftlets on the roof of the cave. Much decaying organic matter in the water produced gases and the air was foul."

DISTRIBUTION: Eastern Caroline Is. (Kusaie).

Except for the absence of specialized hairs on segment VI of the male antenna, this species agrees with Edwards' group B (*fraudatrix* group). The rather reduced tufting of the male antenna, the attenuate mesosome lobes, the triple to quintuple larval head hairs 6 and 5, and many other features indicate a species without any relative closer than *carolinensis* and *gossi*. These differ in many diagnostic characters of adult and larva as indicated in the keys.

35. Culex (Lophoceraomyia) sp.

Larva differs from *gossi* essentially as follows: Antenna darkened only at base; clypeal spine pale. Fifth pentad hair with four branches; siphon about nine times its basal diameter, 4 rather evenly spaced, double or triple hairs on distal one-half, longest hair about one-eighth as long as siphon; saddle posteriorly margined with many long spicules, lateral hair double; 10 anal brushes in barred area; *isc* with four to six branches, three or four of them long.

DISTRIBUTION: Western Caroline Is. (Palau).

PALAU. NGERGOI (Garakayo): One larva, in *Pandanus* axil, Aug. 6, 1945, E. Hagen.

This single larva represents a species which probably is related to *fraudatrix* (Theobald). The long spicules of the saddle and the well-branched *isc* mark it as an unusual species. Identification will have to await the discovery of the male. Possibly belonging to the same species are two females from Auluptagel Island, Palaus, collected by Krauss in September 1952.

Subgenus **Culiciomyia** Theobald

36. Culex (Culiciomyia) nigropunctatus Edwards (fig. 13, *b-d*).

Culiciomyia annulata Theobald, 1907, Monograph Culicidae **4**: 230, figs. 64, 65 (cotype male, female, British Mus.) (*nec Culex annulatus* Schrank).

Culex nigropunctatus Edwards, 1926, Bull. Ent. Res. **17**: 121 (new name for *annulata* Theobald, preoccupied).—Barraud, 1934, Fauna India, Dipt. **5**: 383, fig. 89c.

Culex pullus (Theobald), of Bohart and Ingram, 1946, NAVMED **1055**: 31 (larval misidentification).

Female: Length of wing about 2.5 mm. Median area of vertex with brownish narrow and upright scales, eye margin narrowly pale; mouthparts dark, palpus about one-fifth

proboscis length. Scutum, wing, and scutellum clothed with pale brownish narrow scales; pleural integument straw-colored with a dark-brown band from *ppn* across sternopleuron; one lower mesepimeral bristle; legs dark, femora pale beneath. Abdominal tergites with basal pale bands, broadest on V and VI.

Male: Proboscis reaching to middle of penultimate segment, "long" segment of palpus with outstanding scale-like hairs in a row beneath, last two segments moderately bristled. Subapical lobe of basistyle with an apico-ventral projection crowned with feathery setae, and five groups of specialized setae arbitrarily designated dorsally A-C and ventrally D-E (fig. 13, *d*) : A consists of a leaf and a stout, curved seta; B has one stout and one slender seta on a protuberance; C consists of two slender curved setae which are somewhat separated from a group of straighter ones more basad on the basistyle; D has three stout to moderate setae in a row, most distal one largest, and a slender, more basal seta; E is a stout, hooked seta basad of group B; dististyle with a backward-pointing crest including four to six separate teeth; mesosome lobe with a row of teeth (fig. 13, *c*).

Larva (data based on four specimens from Peleliu) : Antenna tufted and constricted at apical one-third, somewhat darkened beyond tuft, subapical bristles surpassing apical ones, moderately spiculate; clypeal spine very slender and pale; head hair 6 with three or rarely four branches, hair 5 with three or four, hair 4 single and well in front of hair 6; mentum with about 32 fine teeth. Pronotal hairs 1 to 3 single and reaching front of head. Lateral abdominal hairs of III-VI single; comb a patch of scales; first pentad hair with five to six branches, third with six to eight, fifth with two; siphon about 10 times its basal diameter, a membranous "break" at distal two-fifths, two small nearly lateral hairs before it and one beyond (fig. 13, *b*), about eight pecten teeth near base of tube; saddle with some posterior spicules and a slender, single lateral hair; about eight tufts in anal fan; gills longer than saddle; *isc* and *osc* single.

Biology: Larvae in the Oriental Region have been found principally in or near rice fields in grassy ground pools. The only larval specimens known from the Carolines were taken from a tin can.

DISTRIBUTION: India, Malay States, Thailand, Borneo (type locality, Kuching, Sarawak), Celebes, Philippines, Ryukyus, and western Caroline Is.

PALAU. NGAIANGL: One male, light trap, Dec. 1952, J. L. Gressitt. KOROR: one male, two females, Aug. 1952, Hu; seven males, four females, at light, Jan.-Apr. 1953, Beardsley; one female, light trap, Dec. 1952, Gressitt. NGARMALK ("NW. Auluptagel") : One male, light trap, Dec. 1952, Gressitt. PELELIU: Four larvae, in tin can, Aug. 1945, Dorsey.

YAP. YAP: One male, one female, Yaptown, light trap, Nov.-Dec. 1952, Gressitt; two males, one female, Yaptown, July-Aug. 1950, Goss.

CAROLINE ATOLLS. IFALUK: Two males, at light, Aug. 1953, Bates.

The two species of *Culiciomyia* from the Carolines, *nigropunctatus* and *maplei*, belong to Edwards' group A (*fragilis* group), which is Oriental and Australasian in distribution, and is distinguished by the unscaled pleuron. The similarity of *nigropunctatus* to *pullus* Theobald is remarkable in both adults and larvae. The principal differences occur in the male genitalia where *nigropunctatus* has a row of teeth along the ventral edge of the mesosome lateral plate instead of a single large tooth. The pleural markings of *nigropunctatus* are supposed to be black rather than brown as in *pullus*, but this feature is

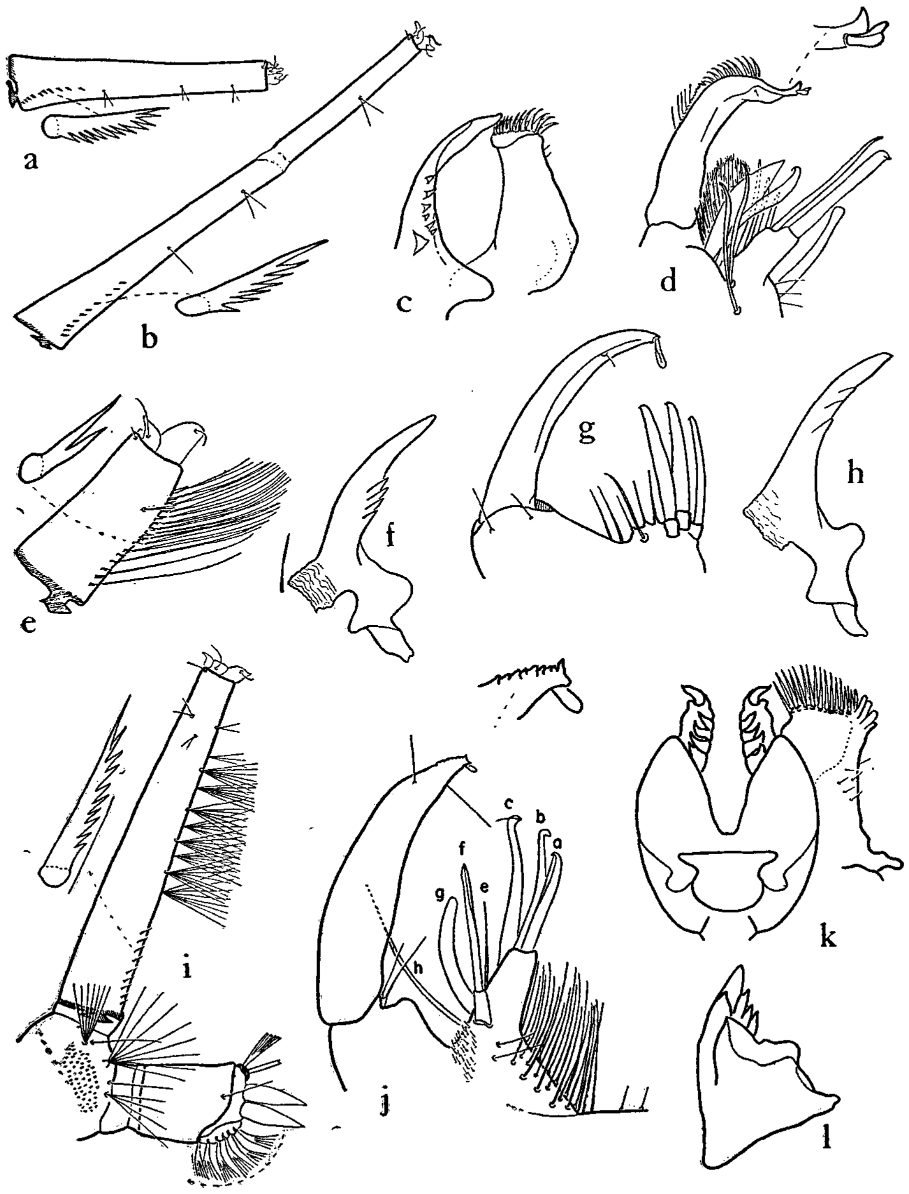

FIGURE 13.—*Culex* (*Culiciomyia*). **a,** *maplei,* siphon, larva. **b-d,** *nigropunctatus: b,* siphon, larva; *c,* mesosome lobe and paraproct, right dorsal view; *d,* tip of style, left ventral view. *Culex* (*Lutzia*): **e-g,** *vorax: e,* siphon, larva; *f,* mesosome lobe, right ventral view. *g,* tip of style, left ventral view. **h,** *fuscanus,* mesosome lobe, right ventral view. *Culex* (*Culex*): **i-l,** *boninensis: i,* posterior segments, larva; *j,* tip of style, left ventral view; *k,* mesosome and paraproct, right dorsal view; *l,* mesosome lobe, dissected view. (*a, i-l* after paratypes.)

not usually well marked in Caroline specimens. The larvae of both species have the so-called membranous "joint" on the siphon.

37. Culex (Culiciomyia) maplei Knight and Hurlbut (fig. 13, *a*).

Culex pullus maplei Knight and Hurlbut, 1949, Washington Acad. Sci., Jour. **39**: 31, figs. 5, 7, 10, 12, 18, 23 (type male, U. S. Nat. Mus.).

Agrees with description of *nigropunctatus* except as follows:

Male: Basistyle without an apico-ventral "feathery" lobe; subapical lobe with five groups of setae about as in figure 13, *d* but group D has one stout and one moderate seta close together and a more basad slender spine with a curved tip; dististyle crest with 11 or 12 separate teeth; mesosome lobe with a single, large, elongate tooth.

Larva (data based on seven specimens from Ponape): Antenna somewhat stouter, tufted at apical two-fifths; head hair 6 with three or four branches, hair 5 with four to seven. Pronotal hairs finer and shorter than in *nigropunctatus*. Lateral abdominal hairs of III-VI single or more often double; fifth pentad double or triple; siphon without membranous "break," six to eight times its basal diameter, with eight to 15 pecten teeth (fig. 13, *a*).

Pupa: Abdominal chaetotaxy has been figured by Knight and Hurlbut (1949).

Biology: Larvae were reported by Knight and Hurlbut (1949) as "very numerous in artificial containers around native dwellings, often being found in polluted water in tin cans and steel drums along with *quinquefasciatus*, and in cement tanks in the foundations of destroyed Japanese houses." They were also found twice in taro leaf axils. The egg rafts were nearly round rather than boat-shaped as in *quinquefasciatus*. Adults were not observed feeding.

DISTRIBUTION: Known only from Ponape Island and the associated small island of Sokas (type locality).

PONAPE: Two males, two females, three pupal skins, seven larvae and skins, Sokehs (Sokas) I., Matalanim, Colonia, Wanikiti, Palieij, steel barrel, tin can, taro axil, Jan.-Mar. 1948, Hurlbut; one female, Colonia, June-Sept. 1950, Adams; seven males, seven females, Kapingamarangi Village, July 23, 1952, Hu.

Although this species is extremely similar to *pullus* in the adult, the larva is so different in lacking the membranous siphon "joint" that I am treating it as a distinct species. As pointed out by Knight and Hurlbut (1949), upper head hair 5 is usually triple in *pullus* but has four to seven branches in *maplei*. Also the lateral abdominal hairs of III-VI are single in *pullus* and usually double in *maplei*.

Subgenus **Lutzia** Theobald

38. Culex (Lutzia) vorax Edwards (fig. 13, *e-g*).

Culex vorax Edwards, 1921, Bull. Ent. Res. **12**: 327, fig. 5d (type male, British Mus.).—Barraud, 1934, Fauna India, Dipt. **5**: 344, fig. 81c.—Bohart and Ingram, 1946, NAVMED **1055**: 70, fig. 35.—La Casse and Yamaguti, 1950, Mosquito fauna of Japan and Korea, 251, pls. 87, 88.

Female: Length of wing about 5.5 mm. Median area of vertex with creamy narrow and dark upright scales; palpus and proboscis speckled with pale scales, those on latter concentrated into a broad but poorly defined median band. Scutum with hairlike brownish and a few creamy scales; scutellum with creamy narrow scales; pleuron with about four patches of dull pale scales, four to six lower mesepimeral bristles; wing scales dark; femora and tibiae variegated with dark and pale scales, anterior surface of hind femur pale on basal one-half except dorsally, pale scaling on apical one-half forming a line to tip of femur; tarsi pale brown. Abdominal tergites II-VII with apical yellow bands of about equal width and with laterobasal (ventral) pale areas.

Male: Palpus longer than proboscis by slightly more than last segment, partly pale; proboscis band narrow; lateral plate of mesosome pointed and with a projecting median clump of teeth (fig. 13, *f*).

Larva: Antenna smooth, with a small single hair near basal one-third; mouth brushes strong; clypeal spine hairlike; head hairs 6 and 5 single, hair 4 in front of hair 6 and divided; mentum with nine large teeth. Pronotal hairs 1 to 3 single. Comb in a patch; first and fifth pentad hairs usually single, third with nine to 12 branches; siphon stout, with a row of hairs associated with a long pecten row (fig. 13, *e*); saddle twice as long dorsally as ventrally, with a single lateral hair; gills small; about 13 tufts in anal fan, *isc* and *osc* single.

Biology: Larvae occur in artificial containers, ground pools, and rock holes. They are predaceous on mosquito larvae as well as on other small aquatic life. In the Bonins their chief prey appeared to be *Aedes albopictus* in artificial containers and *Culex boninensis* in rock holes. The adults will feed on man but are not persistent.

DISTRIBUTION: India, Burma, China, Ryukyus, Japan, Volcano Is., and the Bonin Is. (new record).

BONIN IS. CHICHI JIMA: Seventeen males, three females, one pupal skin, seven larvae, in steel half barrel, stream edge rock pool, algal creek pool, July 7-10, 1951, Bohart; larvae, Jan. 1954, H. Holcomb; one female, June 20, 1949, Mead. HAHA JIMA: One male, two females, sweeping, July 18, 1951, Bohart.

VOLCANO IS. Iwo JIMA: 1945, J. M. Hutzell.

Edwards (1932, Genera Insectorum, Dipt. **194**) divided *Lutzia* into two groups on the basis of tarsal and proboscis markings. The two species considered here both belong in group B characterized by dark proboscis and costa, unbanded tarsi, and rather short larval siphon. The five closely related species in group B occur in the Orient, Australasia, and Africa, and they are separated from one another primarily on the basis of femoral and abdominal markings. The extensively speckled hind femur and broad apical pale bands of the abdomen are characteristic of *vorax*. It is the only mosquito in the Bonin and Volcano Islands with apical pale bands on the abdomen. The pupal chaetotaxy has been described and figured by Asanuma and Nakagawa (1953, Inst. Nat. Res., Misc. Rept. **31**:86-98). Notable are the usually split seta K-I and few-branched seta C-II.

39. Culex (Lutzia) fuscanus Wiedemann (fig. 13, *h*).

Culex fuscanus Wiedemann, 1820, Dipt. Exot. **1**: 9 (type female ?, non-existent).—Barraud, 1934, Fauna India, Dipt. **5**: 341, fig. 81a.

Culex setulosus Doleschall, 1857, Nat. Tijd. Ned.-Ind. **14**: 384 (type female, non-existent).

Culex concolor Robineau-Desvoidy, of Theobald, 1901, Monograph Culicidae **2**: 107, figs. 109, 110, pl. 28.

Differs from description of *vorax* as follows:

Female: Anterior surface of hind femur with numerous dark scales on basal one-half, apical one-half without a line of pale scaling to tip. Abdominal tergites II-IV all dark or with very narrow apical bands.

Male: Lateral mesosome plate with about four long teeth laterally (fig. 13, *h*) rather than a toothed median process.

Biology: According to Barraud (1934, Fauna India, Dipt. **5**: 341) the predatory larvae occur in natural pools, shallow wells, and domestic collections of water. The adults seldom attack man.

DISTRIBUTION: India (type locality), south China, Indonesia, Thailand, Philippines, Carolines (new records given below).

PALAU. BABELTHUAP: One male, Ulimang, at light, Dec. 21, 1947, Dybas. KOROR: One pair, reared from sunken drum containing taro plant, Aug. 1-8, 1952, Hu.

YAP. YAP: One male, July-Aug. 1950, Goss.

From the other four species in Edwards' group B, *fuscanus* is distinguished by the unspeckled hind femur, the rather dark abdominal tergites II-IV, and the male genitalia. This species and *vorax* are the only *Culex* in Micronesia with more than one lower mesepimeral bristle.

Subgenus **Culex** Linnaeus

40. Culex (Culex) boninensis Bohart, n. sp. (fig. 13, *i-l*).

Female: Length of wing 3.3 mm. Palpus and proboscis black (proboscis with a median pale-scaled area beneath in some paratypes), palpus about one-sixth proboscis; vertex in median area with some yellowish narrow curved scales and abundant black upright forked scales; narrow pale scales along eye margin, a lateral spot of pale scales. Scutum brown with small bronzy to black scales, paler around front margin, many black bristles; scutellar scales narrow and bronzy, pleuron with paler integument, three small patches of whitish scales, two on mesepimeron and one on upper sternopleuron, no lower mesepimeral bristle; scales of wing and halter knob dark; legs dark except femora are extensively pale beneath. Abdomen black dorsally as a rule, with basolateral ventral white spots which sometimes barely show in dorsal view, particularly on VII; sternites with basal pale bands.

Male: Palpus longer than proboscis by nearly one-half of terminal segment, last two segments equal and with sparse, short bristles, joints very narrowly pale. Genitalia as in figure 13, *j-l*, basistyle with a dense clump of bristles below subapical lobe.

Larva (data based on 48 specimens from Chichi Jima): Antenna tufted and constricted at distal one-third, darkened beyond and at base, shaft moderately spiculate, subapical bristles reaching as far as apical ones; clypeal spine short, dark, stout, inserted about

its length from mid-line; head hair 6 with three to five (usually four) branches which surpass front of head; hair 5 longer and double (rarely single); hair 4 single, three times as long as clypeal spine, in front of hair 6; mentum with 15 to 19 teeth. Pronotal hairs 1 and 3 long and single. Lateral abdominal hairs of III-V double or rarely triple; comb in a large patch; first and fifth pentad hairs with four to seven branches, third with six to 11; siphon five to six times its basal diameter, with nine to 14 pecten teeth followed at about basal one-third by a ventral unpaired row of nine or 10 hairs with eight to 12 branches (fig. 13, *i*), a small subventral pair, a sublateral and a subdorsal, these small hairs double or triple; saddle complete, minutely spiculate, lateral hair single or double and small; 12 multiple hairs in anal fan, gills one-half to three-fourths as long as saddle, about equal; *isc* with three or rarely two branches; *osc* single.

Pupa: Respiratory trumpet about five times its median diameter (five to seven times in paratypes). K-I double, C-II small and about 10-branched, A-VIII with seven or eight frayed branches, longer paddle hair about one-twelfth as long as paddle rib.

Holotype, male (US) with associated larval and pupal skins, Chichi Jima, Bonin Is., rock hole in creekbed, July 10, 1951, R. Bohart. Paratypes, 71 males, 41 females, two pupal skins, two larval skins, and 46 larvae, same data as holotype but some adults obtained by sweeping shrubbery along creeks. Metatypes, one female, Ani Jima, Bonin Is., metal drum, July 15, 1951, W. Savory; one female, Muko Jima, sweeping vegetation, July 17, 1951, R. Bohart; two females, Haha Jima, sweeping creekbed July 18, 1951, R. Bohart; one female Haha Jima, June 29, 1949, A. R. Mead.

Biology: The larvae were found commonly on Chichi Jima in shaded rock holes in creekbeds. In these situations the water was usually coffee-colored from decaying leaves and berries. *Culex vorax* larvae were frequently seen predators. Adults were taken in shrubbery and flying along creekbeds. However, none attempted to bite, even in dim light.

DISTRIBUTION: Bonin Islands.

In spite of the dark tarsi this species appears to belong to Edwards' group A (*sitiens* group) which is based primarily on the absence of lower mesepimeral bristles. However, because of the absence of tarsal markings, it does not fit into any of the four existing subgroups and perhaps should have a new subgroup erected for it. On the other hand, the larva would not be out of place in the *sitiens* subgroup, and the adult has some points of similarity with members of this subgroup, notably *crinicauda* Edwards. The latter has only the basal two hind tarsal segments banded and the femora, as in *boninensis,* are not speckled. Outstanding differences are the absence in *boninensis* of a hair tuft at the base of the dististyle, an all dark or incompletely banded female proboscis instead of one with a median band, and lateral spots on the abdominal tergites instead of bands.

The male genitalia of *boninensis* have several unusual features. The dististyle is exceptionally simple, the leaflet is not expanded, the lateral mesosome plate is hardly divided into outer and inner sections, and there is a conspicuous tuft of bristles at the base of the subapical lobe of the basistyle. Furthermore, there is a reduction in the number of appendages on the sub-

apical lobe. Starting with the most basal, *Culex* (*Culex*) species customarily have three stout rods (a-c), three somewhat sinuate or serrate filaments (d-f), a leaf-shaped seta (g), and a bristle (h). In *boninensis* the second group is not at all sinuate and consists of only two setae—a slender one (e) and a stout one (f). Both "a" and "f" are almost paddle-shaped in oblique view (lateral view shown in figure 13, *j*). Finally, *boninensis* has the leaf (g) and the bristle (h), but the former is narrowed to a rod.

41. Culex (Culex) quinquefasciatus Say (fig. 14, *a, b*).

Culex quinquefasciatus Say, 1823, Acad. Nat. Sci. Philadelphia, Jour. **3**: 10.—Esaki, 1941, Sixth Pacific Sci. Congr., Proc. **4**: 414.—Swezey, 1942, B. P. Bishop Mus., Bull. **172**: 199.—Bohart and Ingram, 1946, NAVMED **1055**: 8, 22, 32, 44, fig. 51.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 36, plates 9, 10.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31**: 642.—Hull, 1952, U. S. Armed Forces Med. Jour. **3** :1287.—Bailey and Bohart, 1952, Jour. Economic Ent. **45**(6) : 947.

Culex fatigans Wiedemann, 1828, Aussereur. Zweifl. Ins. **1**: 10 (for general synonymy see Edwards, 1932, Genera Insectorum, Dipt. **194**: 208.—Barraud, 1934, Fauna India, Dipt. **5**: 420).

Female: Palpus pale-tipped, proboscis essentially dark; vertex median area with whitish narrow scales. Scutum uniformly pale brown; scutellum narrow-scaled; wing dark; tibiae and tarsi unicolorous; abdominal dorsum with basal creamy bands, some of which are usually evenly rounded, the band usually detached from lateral creamy spots.

Male: Palpus hairy distally, longer than proboscis by last segment. Abdominal bands less regular than in female, usually attached to lateral spots. Mesosome characteristic (fig. 14, *b*).

Larva: Antenna relatively stout, constricted and tufted at distal two-thirds; clypeal spine slender; head hairs 6 and 5 with five or more branches, hair 4 single. Pronotal hairs 1 and 3 single. Comb in a patch; first, third, and fifth pentad hairs with five or more branches; siphon with four pairs of tufts, subapical one usually out of line, basal tufts many-branched, apical ones with two to four branches (fig. 14, *a*) ; pecten with about nine teeth; saddle complete, lateral hair short and single; about 12 anal brushes; gills moderate, equal; *isc* double, *osc* single.

Pupa: The chaetotaxy has been described by Penn (1949, Pacific Science **3**: 3-85).

Biology: Larvae of this well known species are commonly found in artificial containers and ground pools. Water polluted by laundry waste or sewage is entirely acceptable to *quinquefasciatus*. The adults are severe pests at night and are of additional concern as vectors of filaria and of encephalitides. Egg rafts tend to be boat-shaped.

DISTRIBUTION: Worldwide in tropical and subtropical climates (type locality, North America). Many specimens were examined from most of the island groups and many of the inhabited islands under consideration, including the Volcano and Bonin groups and Wake Island. The following records are perhaps the first specific ones from the Bonins.

BONIN IS. CHICHI JIMA: One male, two larvae, metal drum, July 11, 1951, Bohart. MUKO JIMA: One female, metal bucket, July 17, 1951, Bohart.

Recent investigations by several workers on the relationships of *pipiens* Linnaeus and *quinquefasciatus* have produced much valuable information. However, there is still no conclusive proof that they belong to the same species. In any case the Micronesian and Bonin material I have examined all seems to be unquestionably *quinquefasciatus*. According to Edwards' classification it belongs in group B (*pipiens* group) and to the *pipiens* subgroup which is characterized by the unbanded tarsi and proboscis.

42. Culex (Culex) litoralis Bohart (fig. 14, *c, d*).

Culex litoralis Bohart, 1946, Biol. Soc. Washington, Proc. **59**: 43, figs, 17-23 (type male, U. S. Nat. Mus.).—Bohart and Ingram, 1946, NAVMED **1055**: 43, fig. 47.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 24, pls. 5, 6.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31**: 647.—Hull, 1952, U. S. Armed Forces Med. Jour. **3**: 1294.—Bailey and Bohart, 1952, Jour. Economic Ent. **45**: 947.

Female: Similar to *annulirostris* except that vertex is largely covered with pale yellowish narrow and forked scales, proboscis ring covers one-fourth to one-third its length, scutal scales somewhat scimitar-shaped, imparting a shaggy look, wing dark-scaled, femora not speckled in front, fore tibia unspotted, abdominal dorsum with broad whitish yellow basal bands on II-VII, bands occupying one-half or more of each segment and often produced at mid-line.

Male: Lateral plate of mesosome distinctive, dorsal angle sharp and spiculate (fig. 14, *d*).

Larva: Similar to *sitiens* but head hairs 6 and 5 double or triple, pronotal hairs weak, fifth pentad hair double or triple, pecten teeth stouter and with fewer subteeth (fig. 14, *c*), siphon with an irregular row of 10 to 12 ventral tufts and two small sublateral tufts; saddle covering less than half of anal segment, with a single slender hair outside sclerotized area.

Biology: Although rare at other times, larvae are found rather commonly during the rainy season in nearly fresh to saline water in coral rock holes and other containers along the coast. The habits of the adults are unknown.

DISTRIBUTION: Guam, Rota (type locality), Tinian, Saipan, and Anatahan Islands of the Mariana group; possibly also found in New Guinea and the Philippines (Bohart and Ingram 1946, NAVMED **1055**: 44). The Saipan and Anatahan records are new. Guam records are Pt. Ritidian, Tumon Bay, Pt. Oca, Umatac, Port Ajayan, and Talagai Bay.

N. MARIANA IS. ANATAHAN: Two pupae, 23 larvae, northwest coast, brackish rock hole, Aug. 1951, Bohart.

S. MARIANA IS. SAIPAN: Males, females, seven larvae, northwest coast, brackish pot holes, Sept. 1945, Hagen. TINIAN: Four larvae, White Beach, rock pools, Aug. 1944, Bailey, Cott; four males, four females, 18 larvae, Gurgan Pt., Mar. 1945, Dybas. ROTA: Two males, one female, one pupal

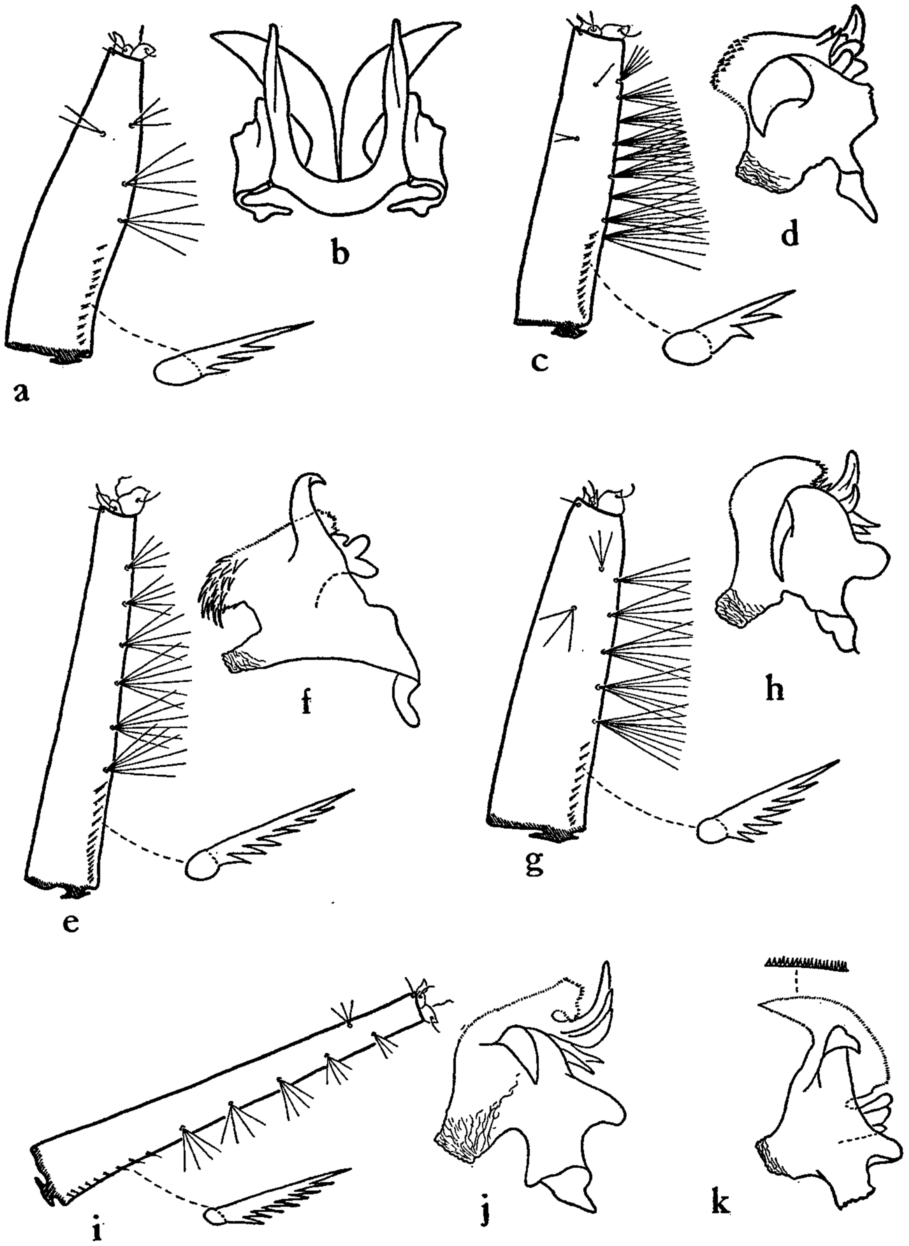

FIGURE 14.—*Culex* (*Culex*), adult males and fourth stage larvae. **a, b,** *quinquefasciatus: a,* siphon, larva; *b,* mesosome, ventral view. **c, d,** *litoralis: c,* siphon, larva; *d,* mesosome lobe, dissected view. **e, f,** *annulirostris annulirostris: e,* siphon, larva; *f,* mesosome lobe, dissected view. **g, h,** *sitiens: g,* siphon, larva; *h,* mesosome lobe, dissected view. **i, j,** *tritaeniorhynchus: i,* siphon, larva; *j,* mesosome lobe, dissected view. **k,** *bitaeniorhynchus,* mesosome lobe, dissected view.

skin, 19 larvae, coral rock holes, Oct. 1945, Bohart and Ingram. GUAM: Larvae, Port Ajayan, June 1945, Dybas.

Four species from Micronesia and the Bonin Islands clearly belong in Edwards' group A (*sitiens* group) and in the *sitiens* subgroup characterized by the banded proboscis and tarsi, the mottled scutum, and the absence of lower mesepimeral bristles. These species are *sitiens, annulirostris, litoralis,* and *tritaeniorhynchus*. The first two of these are often found on the same islands over much of Micronesia and the first three are known from Guam. Adult females taken in biting collections may be difficult to determine by markings, especially if somewhat rubbed. Male genitalia and larvae are diagnostic, however.

The Mariana representative of *annulirostris,* subspecies *marianae,* appears to be readily identifiable by the pale scales along the posterior edges of many of the abdominal tergites. This pattern is particularly well marked in specimens from Saipan.

43. Culex (Culex) annulirostris annulirostris Skuse (fig. 14, *e, f*).

Culex annulirostris Skuse, 1889, Linn. Soc. New South Wales, Proc. II, **3**: 1737 (type female, Macleay Mus., Sydney).—Edwards, 1924, Bull. Ent. Res. **14**: 394.—Bohart and Ingram, 1946, NAVMED **1055**: 17, 32.

Culex palpalis Taylor, 1912, Bull. Northern Terr. **1** (A): 29 (type female, Univ. Sydney).

Culex somerseti Taylor, 1912, Australia Dept. Public Health, Ann. Rept., 28.

Culex consimilis Taylor, 1913, Australia Inst. Trop. Med. Rept. for 1911, 8 (type female, Univ. Sydney).

Culex simplex Taylor, 1913, Ent. Soc. London, Trans. **1913**: 698.

Female: Length of wing about 3.5 mm. Vertex with pale to brownish narrow scales, many dark and a few pale forked scales, a lateral spot of dull pale scales; palpus pale-tipped; proboscis with a creamy band covering median one-fifth to two-sevenths; scutal integument dark, covered with many small bronzy and pale narrow scales; scutellum with narrow scales only; pleuron pale brown, darker in spiracular area and between creamy scale patches on sternopleuron; wing dark-scaled except for a row along hind margin of costa; femora conspicuously speckled with yellow and dark scales; front tibia with an often inconspicuous row of pale spots in front, associated with a row of bristles; tarsi with very narrow pale bands covering joints, last often nearly dark. Abdominal tergites with basal creamy bands which are medially produced on III-VI or at least on one of these segments, bands occupying less than half of tergites, VII with some apical pale scales.

Male: Palpus longer than proboscis by its last segment, pale banded, with many long hairs toward apex. Lateral plate of mesosome distinctive, dorsal angle toothed and sharp (fig. 14, *f*).

Larva: Antenna constricted and tufted at distal two-fifths, part beyond tuft darkened, many basal spicules; clypeal spine strong and dark; head hair 6 triple or quadruple, hair 5 with three to six branches, hair 4 single and slender; mentum with 15 to 17 teeth. Pronotal hairs long and strong, single except four double and seven triple. Comb of many small scales in a patch; third pentad hair with about eight branches, fifth with about five

branches; siphon about six times its basal diameter (fig. 14, *e*), each side with five or six lateroventral tufts; saddle complete with a small single to triple lateral hair; anal fan of about 12 brushlike hairs; gills pointed or narrowly rounded and usually longer than saddle; *osc* single, *isc* double to quadruple.

Pupa: The chaetotaxy has been described and figured by Penn (1949, Pacific Science **3**: 3-85).

Biology: Larvae occur commonly in fresh water in ground pools and artificial containers, rarely in other situations. The adults are a nuisance in the evening and at night. Brug (1937, Geneesk. Tijd. Ned.-Ind. **77**: 3202-3206) has shown its potentiality as a vector of Japanese B encephalitis. Pipkin (1953, unpublished address, Eighth Pacific Sci. Congress, Manila) has shown it to be a probable vector of filariasis on Truk.

DISTRIBUTION: Widespread in Australasia, Indonesia, and the Philippines. The type locality is Australia. The typical subspecies is replaced in the Mariana Islands by subspecies *marianae*.

PALAU. KOROR: One female, July 1951, Gressitt. PELELIU: Ten larvae, road rut, July 1945, Dybas.

CAROLINE ATOLLS. TOBI: One female, Sept. 1952, Krauss. WOLEAI: One female, Faluap, Jan. 1938, Esaki. IFALUK: One male, one female, at light, Aug. 1953, Bates. SATAWAN: One male, More I., Nov. 1952, Beardsley.

TRUK. WENA (Moen), TON, TONOAS: Fourteen males, 113 females, one pupa, eight larvae, Feb., Mar., Apr., July, Nov., Dec., 1935, 1945, 1949, 1952, Ingram, Potts, Ono, Gressitt, Hu, Beardsley.

PONAPE. One male, four females, Colonia, June-Jan. 1939-1953, Esaki, Adams, Clarke, Gressitt.

See discussion under *litoralis*.

44. Culex (Culex) annulirostris marianae Bohart and Ingram.

Culex annulirostris marianae Bohart and Ingram, 1946, NAVMED **1055**: 42, fig. 49.—Yamaguti and La Casse, Mosquito fauna of Guam, 18, pls. 3, 4.—Reeves and Rudnick, 1951, Am. Jour. Tropical Med. **31**: 643.—Hull, 1952, U. S. Armed Forces Med. Bull. **3**: 1289.—Bailey and Bohart, 1952, Jour. Economic Ent. **45**: 947.

Adult: Differs from the typical subspecies primarily by the presence of a narrow line of dull yellowish scales along apices of abdominal tergites II-IV and sometimes also on V and VI.

Larva: Usually with teeth of mentum somewhat more blunt; gills shorter on the average, usually shorter than saddle.

Biology: Larvae are collected in fresh or slightly brackish water of ground pools, marshy lake edges, concrete cisterns, and artificial containers. They are particularly common from August to March. In spite of the abundance of the larvae, the adults are rather rarely seen. In the reports made by Bohart and Ingram (1946, p. 43) and Yamaguti and La Casse (1950,

p. 23), *marianae* was not observed to feed on man. However, Reeves and Rudnick (1951) recorded 16 females out of 5,080 taken in habitations and 11 of these contained human blood. Also, the same authors reported 289 female *marianae* in animal traps of which 287 were attracted to equine, one to bovine, and one to human occupants. Further, two out of 7,767 specimens of mosquitoes attracted to man in nature were *marianae*. These figures indicate that man must be considered as a host of this subspecies, but to a far lesser degree than typical *annulirostris*.

DISTRIBUTION: Southern and northern Mariana Is. Type locality, Chalan Kanoa, Saipan.

N. MARIANA IS. PAGAN: Five larvae, cement cistern, July 1951, Bohart. ANATAHAN: One male, one female, two pupal skins, three larvae, tin bucket, Aug. 1951, Bohart.

S. MARIANA IS. SAIPAN: Two females, five larvae, As Mahetog and Marpi Pt., tin cans and cistern, Nov., Dec. 1944, Dybas; six larvae, Tanapag and Fina Susu, crock, drum, bucket, Jan. 1949, Maehler; six males, two females, one pupal skin, two larvae, Chalan Kanoa, marshy pool and concrete cistern, June, Aug. 1951, Bohart. TINIAN: Three larvae, Mar. 1945, Hagen; 10 larvae, Lake Hagoi, road ruts, Oct. 1945, Dybas. AGIGUAN: One male, at light, June 1952, Kondo. ROTA: One female, Sonson, Oct. 1945, Necker; one male, five females, one larva, Poniya Pt., cistern and stream pool, Oct. 1945, Bohart, Ingram. GUAM: Two hundred and ninety-two adults, 139 larvae, Agana, Piti, Yona, Barrigada, Yigo, "Com. Mar.," Marine Drive, Northwest Field, Sinajana, Ordot, Pago Valley, Asan, Ylig River, Inarajan, Merizo, Almagosa Springs, in rock pools, stream pools, ground pools, marshy pools, and a wooden box, Nov., Dec., Mar. 1948, W. C. Reeves; six males, 10 females, three larvae, Port Ajayan, road rut, June 1945, Dybas.

See discussion under *litoralis*.

45. Culex (Culex) sitiens Wiedemann (fig. 14, *g, h*).

Culex sitiens Wiedemann, 1828, Aussereur. Zweifl. Ins. **1**: 542.—Bohart and Ingram, 1946, NAVMED **1055**: 18, 32, 43, fig. 48.—Yamaguti and La Casse, 1950, Mosquito fauna of Guam, 30, pls. 7, 8.—Bailey and Bohart, 1952, Jour. Economic Ent. **45**: 947.

Culex impellens Walker, 1860, Linn. Soc. London, Proc. **4**: 91 (type female, British Mus.).

Culex microannulatus Theobald, 1901, Monograph Culicidae **1**: 353, fig. 69, pl. 18 (types, male, female; British Mus.).

Culex nigricephala Leicester, 1908, Inst. Med. Res. F. M. S. **3**: 149 (types, male, female; British Mus.).

Culex jepsoni Theobald, 1910, Entomologist **43**: 58 (type, female, British Mus.).

Culicelsa paludis Taylor, 1913, Australia Inst. Tropical Med. Rept. for 1911, 9, female.

Culicada annulata Taylor, 1914, Ent. Soc. London, Trans. **1913**: 669.

Culicelsa annulirostris milni Taylor, 1914, Ent. Soc. London, Trans. **1914**: 196.

Synonymy after Barraud, 1934, Fauna India, Dipt. **5** and Edwards, 1924, Bull. Ent. Res. **14**: 351-401.

Female: Similar to *annulirostris* except that front tibia has no row of pale spots, and abdominal tergites have relatively narrow basal creamy bands which may be convex or irregular but not pointed on III-VI.

Male: Lateral plate of mesosome distinctive, dorsal angle broadly rounded (fig. 14, *h*.)

Larva: Similar to *annulirostris* but clypeal spine is short and stout, head hair 6 with three to six branches, hair 5 with five to eight branches, siphon 4.0 to 4.5 times its basal diameter, with two lateral tufts in addition to lateroventral ones (fig. 14, *g*); lateral hair of anal segment usually single and longer than saddle; gills short and globular.

Pupa: The chaetotaxy has been described and figured by Penn (1949, Pacific Science 3: 3-85).

Biology: Larvae occur in small collections of brackish water or occasionally of fresh water. Brackish water in coral rock holes or in boats are favored places. Adults feed readily on man at night but are not as pestiferous as the related species, *annulirostris*.

DISTRIBUTION: Widespread in the Australasian and Oriental Regions. In Micronesia it is represented on all the island chains except the Marshalls and Gilberts.

S. MARIANA IS. GUAM: One male, five females, seven larvae, Pt. Oca, Sept. 1951, Bohart; two males, five females, 26 larvae, Port Ajayan, brackish rock pool, June 1945, Dybas, Hagen.

YAP. YAP I.: Three females, one male, Kolonia, July-Aug. 1950, Goss.

CAROLINE ATOLLS. NGULU: Three males, one female, Oct. 1945, Dorsey. ULITHI: Two larvae, Nov. 1944, Hensill. FARAULEP: One female, Sept. 1952, Krauss. NOMWIN: One male, Feb. 1954, Beardsley.

TRUK. WENA (Moen): Four larvae, two pupae, brackish water in boat on beach, Dec. 1945, Ingram.

See discussion under *litoralis*.

46. Culex (Culex) tritaeniorhynchus Giles (fig. 14, *i*, *j*).

Culex tritaeniorhynchus Giles, 1901, Bombay Nat. Hist. Soc., Jour. **13**: 606 (type female, British Mus.).—Barraud, 1934, Fauna India, Dipt. **5**: 404, figs. 94b, 95.—Bohart and Ingram, 1946, NAVMED **1055**: 81, fig. 50.—La Casse and Yamaguti, 1950, Mosquito fauna of Japan and Korea, 230, plates 79, 80.

Culex annulus Theobald, 1901, Monograph Culicidae **1**: 358 (type female, British Mus.).

Culex biroi Theobald, 1905, Mus. Nat. Hungarici, Ann. **3**: 82 (type male, female, Nat. Mus. Hungary, Budapest).

Female: Similar to *annulirostris* but median area of vertex with narrow pale scales and dark-brown forked ones, band on proboscis occupying about two-ninths its length, some pale scales toward base beneath, femora unspeckled, tarsal bands not always covering joints, abdominal dorsum with moderate pale basal bands, not produced in mid-line.

Male: Lateral plate of mesosome distinctive, dorsal angle broadly rounded, minutely spiculate (fig. 14, *j*).

Larva: Similar to *annulirostris* but head hair 6 double, hair 5 triple, siphon about seven times its basal diameter, parallel-sided on distal one-half, with a subdorsal tuft in addition to five subventral tufts (fig. 14, *i*).

Biology: In the Orient this species breeds in a variety of fresh-water habitats such as ground pools, rice paddies, margins of slow flowing streams, rock pools, wells, and artificial containers. In the Bonins no rice paddies were seen but *tritaeniorhynchus* larvae were collected from most of the other situations. Adults feed at night and the species is considered a likely vector of Japanese B encephalitis in Japan, the Soviet Far East, and Okinawa (Bohart and Ingram, 1946, p. 83). Horses and man are favored sources for blood.

DISTRIBUTION: Tropical and subtropical countries from Egypt east to Celebes, north to the Ryukyus, Japan, the Bonins, and the Soviet Far East. The type locality is Travancore, India. The species has not previously been reported from the Bonin Islands.

BONIN IS. CHICHI JIMA: Twenty-one males, 10 females, four pupal skins, nine larvae and larval skins, open cistern, crock, streambed rock pool, July 7-10, 1951, Bohart.

See discussion under *litoralis*.

47. Culex (Culex) bitaeniorhynchus Giles (fig. 14, *k*).

Culex bitaeniorhynchus Giles, 1901, Bombay Nat. Hist. Soc., Jour. **13**: 607 (type non-existent).—Edwards, 1922, Indian Jour. Med. Res. **10**: 282, figs. 41-49.—Barraud, 1934, Fauna India, Dipt. **5**: 391, figs. 90-b, 192-h.—Bohart and Ingram, 1946, NAVMED **1055**: 77, fig. 43.—La Casse and Yamaguti, 1950, Mosquito fauna of Japan and Korea, 201, pls. 67, 68.

Taeniorhynchus tenax Theobald, 1901, Monograph Culicidae 2: 198 (type female, British Mus.).

Grabhamia ambiguus Theobald, 1903, Monograph Culicidae **3**: 248 (holotype male, British Mus.).

The complicated synonymy of this species is given by Barraud (1934) and Edwards (1922). Only the more pertinent references are listed above.

Female: Length of wing about 4.5 mm. Median area of vertex with coppery narrow and dark-forked scales, proboscis with a median pale band occupying about one-fourth its length, scutal scales mostly dark brown with patches of coppery ones, scales of *apn, ppn,* and scutellum dark, wing lightly speckled with pale scales toward leading edge, halter

knob dark, femora and tibiae speckled, tarsi with narrow yellowish joint bands, abdominal tergites with median basal yellow patches on IV-VII and lateral apical spots which coalesce into broad bands on VI and VII, VII mostly pale.

Male (based on Okinawan specimens): Palpus longer than proboscis by most of last two segments. Mesosome shape peculiar, dorsal angle sharply projecting (fig. 14, *k*).

Larva (based on Okinawan specimens): Antenna tufted at middle; clypeal spine long and pale; head hairs 6 and 5 rather short, usually double or triple; mentum triangular with about 100 minute teeth. Pronotal hairs long. Comb of four to six spinelike scales in an irregular row; siphon six to eight times its basal diameter, parallel-sided toward apex, a few minute pale pecten teeth at extreme base of tube, siphon hairs 6 to 8 nearly ventral, short ones with few branches; lateral hair of saddle small and split; gills equal, pointed, 1.5 to 2.0 times as long as saddle.

Biology: Larvae occur commonly throughout the Orient in rice paddies, ponds, and slow streams, usually in association with green algae. Adults occasionally enter houses at night to seek human blood but they do not seem to be serious pests. They have been accused of carrying Japanese B encephalitis in the Soviet Far East. Eggs are laid in crescentic masses.

DISTRIBUTION: Africa, Oriental Region (type locality, Travancore, India), Japan, New Guinea, Soviet Far East, Australia, Palau Is. (new record).

PALAU. BABELTHUAP: Two females, Ulimang, blooded in bed net, at light, Dec. 10-16, 1947, Dybas.

Edwards' group A (*sitiens* group) and the *bitaeniorhynchus* subgroup, in which this species belongs, is composed of large mosquitoes, with the scutum pale in front or across the middle, with partly apical pale markings on abdominal tergites, the larval siphon very long and with few pecten teeth, and the comb teeth few and large. *Bitaeniorhynchus* is the only member of the subgroup known from Micronesia. Throughout its range it occurs in a number of color phases which have been given names but which can hardly be called subspecies. The two female specimens I have seen from Babelthuap agree with the variety *ambiguus* in which the wings are mostly dark-scaled and the abdominal tergites have baso-median yellow patches and apico-lateral yellow marks which form bands on the more posterior segments. The pupal chaetotaxy has been described and figured by Asanuma and Nakagawa (1953). The single or split seta K-I and few-branched C-II are similar to those of *vorax* but in *bitaeniorhynchus* the paddle is banded and longer than broad.